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# ***Monitoring System and Installation Plan for Operable Unit 3-13, Group 5, Snake River Plain Aquifer***



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Unit 3-13, Group 5, Snake River Plain Aquifer***

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## **ABSTRACT**

This Monitoring System and Installation Plan provides the general strategy for accomplishing the Operable Unit 3-13 Group 5, Snake River Plain Aquifer remedial action. This work plan presents the design basis and data quality objectives that were developed based upon an evaluation of remedial action requirements set forth in the Operable Unit 3-13 Record of Decision. Summaries of the primary remedial action design elements are discussed, including the Plume Evaluation Field Sampling Plan and the Long-Term Monitoring Plan. The Field Sampling Plan was developed to determine if contingent pump and treat remediation of the Snake River Plain Aquifer is necessary. The Long-Term Monitoring Plan was developed for long-term monitoring of the Idaho Nuclear Technology and Engineering Center groundwater plume outside of the Idaho Nuclear Technology and Engineering Center fence and to monitor the flux of contamination in the Snake River Plain Aquifer migrating from beneath Idaho Nuclear Technology and Engineering Center. This work plan also references or presents the supporting documentation required for performing the remedial action, including the project health and safety plan, waste management plan, project schedule and cost estimate, data management plan, quality assurance project plan, and various other documents required for implementation of the Group 5 remedial action.



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## ACRONYMS

AA	alternative actions
ARAR	applicable or relevant and appropriate requirement
ARDC	Administrative Records and Document Control
ART	allowable risk threshold
BBWI	Bechtel BWXT Idaho, LLC
BLM	Bureau of Land Management (Department of Interior)
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CIR	CERCLA Incremental Risk
COC	contaminant of concern
CPP	(Idaho) Chemical Processing Plant
DMP	data management plan
DO	dissolved oxygen
DOE	U.S. Department of Energy
DOE-ID	U.S. Department of Energy Idaho Operations Office
DQO	data quality objective
DR	decision rule
DS	decision statement
EPA	Environmental Protection Agency
ER	environmental restoration
ER-DMP	Data Management Plan for Idaho National Engineering Laboratory Environmental Restoration Program
ERIS	Environmental Restoration Information System
FFA/CO	Federal Facility Agreement and Consent Order
FS	feasibility study

FSP	field sampling plan
FSS	feasibility study supplement
GIS	geographical information system
GSA	General Services Administration
HASP	health and safety plan
HDR	INEEL Hydrologic Data Repository
HI	hazard index
HLW	high-level waste
HLWIR	High Level Waste Incremental Risk
ICPP	Idaho Chemical Processing Plant
ICDF	INEEL CERCLA Disposal Facility
IDHW	Idaho Department of Health and Welfare
IEDMS	Integrated Environmental Data Management System
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
IR	Facility Closure Incremental Risk
LTMP	long-term monitoring plan
MCL	maximum contaminant levels
MCP	management control procedure
MRDS	Monitoring Report/Decision Summary Report
MSIP	Monitoring System and Installation Plan
NPDES	National Pollutant Discharge Elimination System
NRF	Naval Reactor Facility
NSIR	New Site Incremental Risk
OIS	Optical Imaging System
OU	operable unit

PD	Program Directive
QAPjP	Quality Assurance Project Plan
RAO	remedial action objective
RD/RA	remedial design/remedial action
RI/BRA	remedial investigation/baseline risk assessment
RI/FS	remedial investigation/feasibility study
ROD	Record of Decision
ShoBan	Shoshone Bannock (Tribal Council)
SMO	Sample Management Office
SOW	Scope of Work
SRPA	Snake River Plain Aquifer
TRL	total risk level
WAG	waste area group



# **Monitoring System and Installation Plan for Operable Unit 3-13, Group 5, Snake River Plain Aquifer**

## **1. INTRODUCTION**

In accordance with the Idaho National Engineering and Environmental Laboratory (INEEL) Federal Facility Agreement and Consent Order (FFA/CO) (DOE-ID 1991), the Department of Energy (DOE) submits the following Monitoring System and Installation Plan (MSIP) for the remediation of the Idaho Nuclear Technology and Engineering Center (INTEC), Waste Area Group (WAG) 3, Operable Unit (OU) 3-13, Group 5, Snake River Plain Aquifer. The Remedial Design/Remedial Action Scope of Work (RD/RA SOW) (DOE-ID 2000a) for Group 5 is in accordance with the signed OU 3-13 Record of Decision (ROD) (DOE-ID 1999), describes the remedial design/remedial action process, and identifies the tasks for the Group 5 remedy under the ROD.

The RD consists of a series of engineering documents that detail the steps to be taken during the RA in order to meet the remedial action objectives established in the ROD; its goal is the successful planning of the RA phase of the project. The RA phase includes the elements, systems, and actions necessary for successful implementation of the remedy.

### **1.1 Background**

The INTEC, formerly known as the Idaho Chemical Processing Plant (ICPP), is located in the south-central area of the INEEL in southeastern Idaho (Figure 1-1). From 1952 until 1992, operations at the INTEC primarily involved reprocessing spent nuclear fuel from defense projects. This entailed extracting reusable uranium from spent fuel. Liquid waste generated from the reprocessing activities that ceased in 1992 is stored in an underground tank farm at the INTEC. This waste was previously treated using a calcining process at the facility. Both soil and groundwater contamination have resulted from these operations. Under the FFA/CO, the U.S. Environmental Protection Agency (EPA), the Idaho Department of Health and Welfare (IDHW), and the DOE (also referred to as the Agencies) are directing cleanup activities to reduce human health and environmental risks to acceptable levels. Per the FFA/CO, the INTEC was designated as WAG 3. In order to facilitate remediation of the INTEC, WAG 3 was further divided into OUs comprised of individual contaminant release sites.

Several phases of investigation have been performed at the OUs within WAG 3. A comprehensive remedial investigation/baseline risk assessment (RI/BRA) (DOE-ID 1997a) was conducted for OU 3-13 to determine the nature and extent of contamination and corresponding potential risk to human health and the environment under various exposure pathways and scenarios. Based on the remedial investigation/feasibility study (RI/FS) results, INTEC release sites were further segregated into seven groups based on contaminants of concern (COCs), accessibility, or geographic proximity to allow analysis of remedial action alternatives in the WAG 3 Feasibility Study (FS) (DOE-ID 1997b and 1998). The contaminated portion of the Snake River Plain Aquifer (SRPA) outside the INTEC security fence where COC concentrations in groundwater exceed drinking water standards was designated as Group 5 in the OU 3-13 ROD.

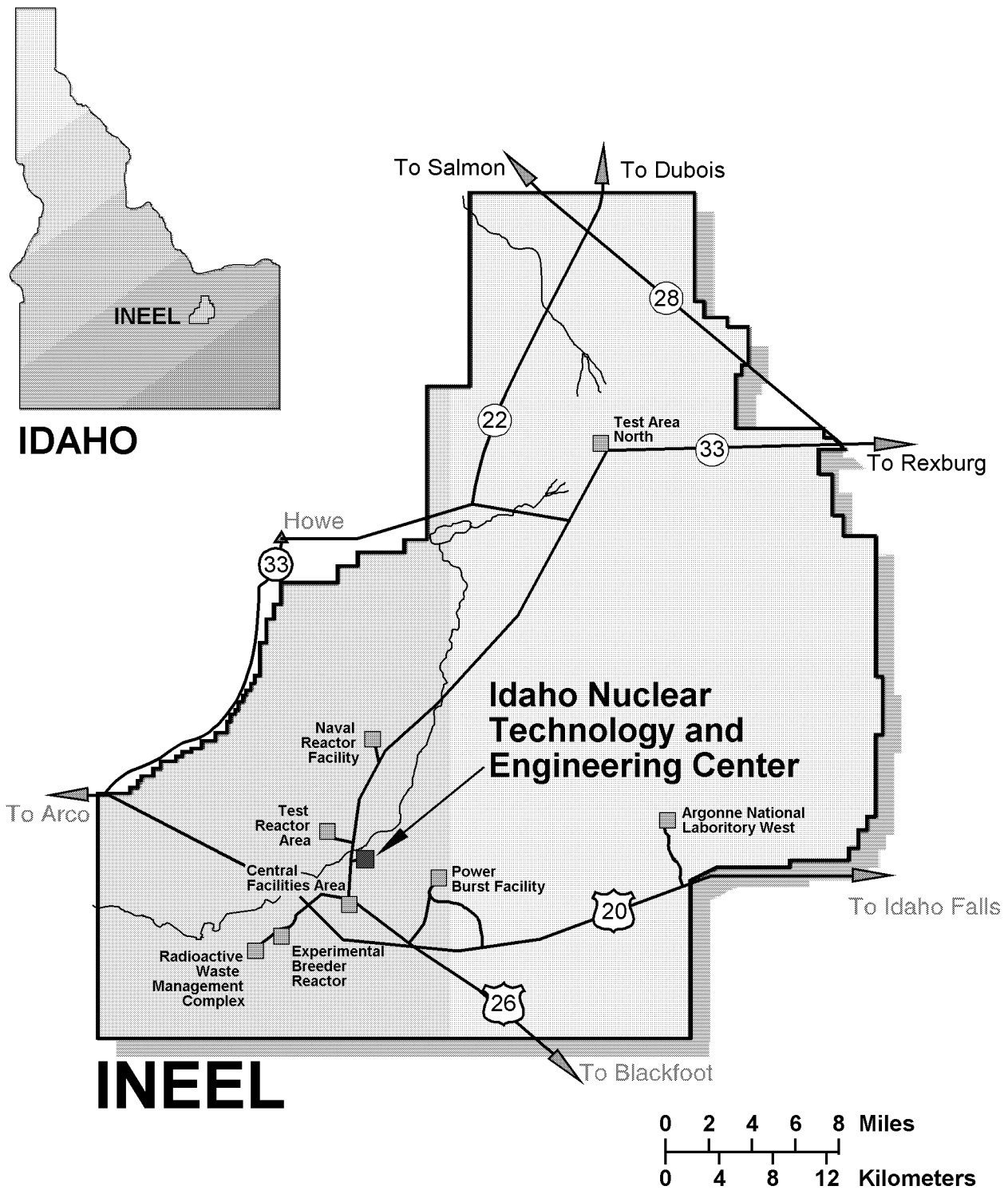


Figure 1-1. Map showing location of the INTEC at INEEL.

The major human health threat posed by contaminated SRPA groundwater is exposure to radionuclides via ingestion by future groundwater users. Based on the groundwater simulations presented in the FS (DOE-ID 1997b) and FS Supplement (FSS) (DOE-ID 1998), removal of the existing percolation ponds from service will significantly reduce the concentrations of contaminants in SRPA groundwater by 2095. Additional RA may be necessary to meet the groundwater maximum contaminant levels (MCLs) for beta particle and photon-emitting radionuclides. RA for the SRPA is bounded by the contaminant plume that exceeds Idaho groundwater quality standards or the federal MCLs for tritium (H-3), strontium-90 (Sr-90), and iodine-129 (I-129). Maps of the H-3, Sr-90, and I-129 plumes are presented in Figures 1-2 through 1-4, respectively.

## **1.2 Selected Remedy**

An interim action is selected for the SRPA as described in the OU 3-13 ROD. While the remediation of contaminated SRPA groundwater outside the INTEC security fence is final, the final remedy for the contaminated portion of the SRPA inside the INTEC security fence is deferred to the tank farm RI/FS investigation, which has been designated as OU 3-14. Because the SRPA groundwater contaminant plume associated with INTEC operations is divided into two zones, the remedial action described herein is classified as an interim action. The selected interim action remedy for the SRPA is Institutional Controls with Monitoring and Contingent Remediation. The SRPA interim action remedy includes the following:

1. Implement institutional controls over the area of the aquifer that exceeds the MCLs for H-3, Sr-90, and I-129 (to include a DOE-ID directive limiting access) to prevent groundwater use while INTEC operations continue and to restrict future groundwater use (through noticing this restriction to local county governments, Shoshone Bannock [ShoBan] Tribal Council, General Services Administration [GSA], Bureau of Land Management [BLM], etc.), including site access restrictions, drilling restrictions, and maintenance during DOE operations at INTEC.

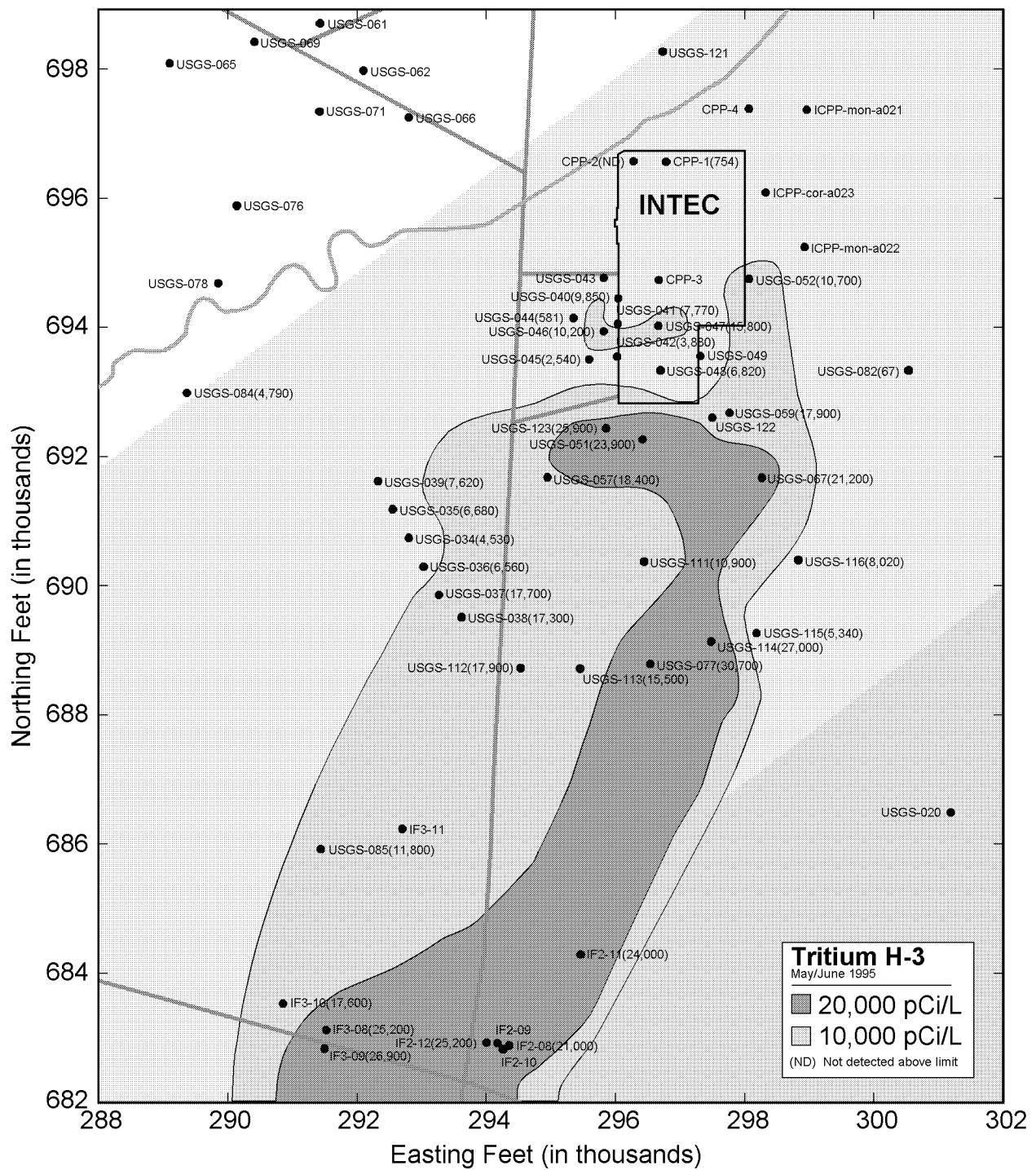
Implementation: This remedy is being implemented through Institutional Controls identified and described in the OU 3-13 RD/RA SOW.

2. Implement institutional controls, including land use restrictions to prevent the use of SRPA groundwater over the area of the aquifer that exceeds the MCLs for H-3, Sr-90, and I-129, until drinking water standards are met, which is projected to occur by 2095.

Implementation: This remedy is being implemented through Institutional Controls identified and described in the OU 3-13 RD/RA SOW.

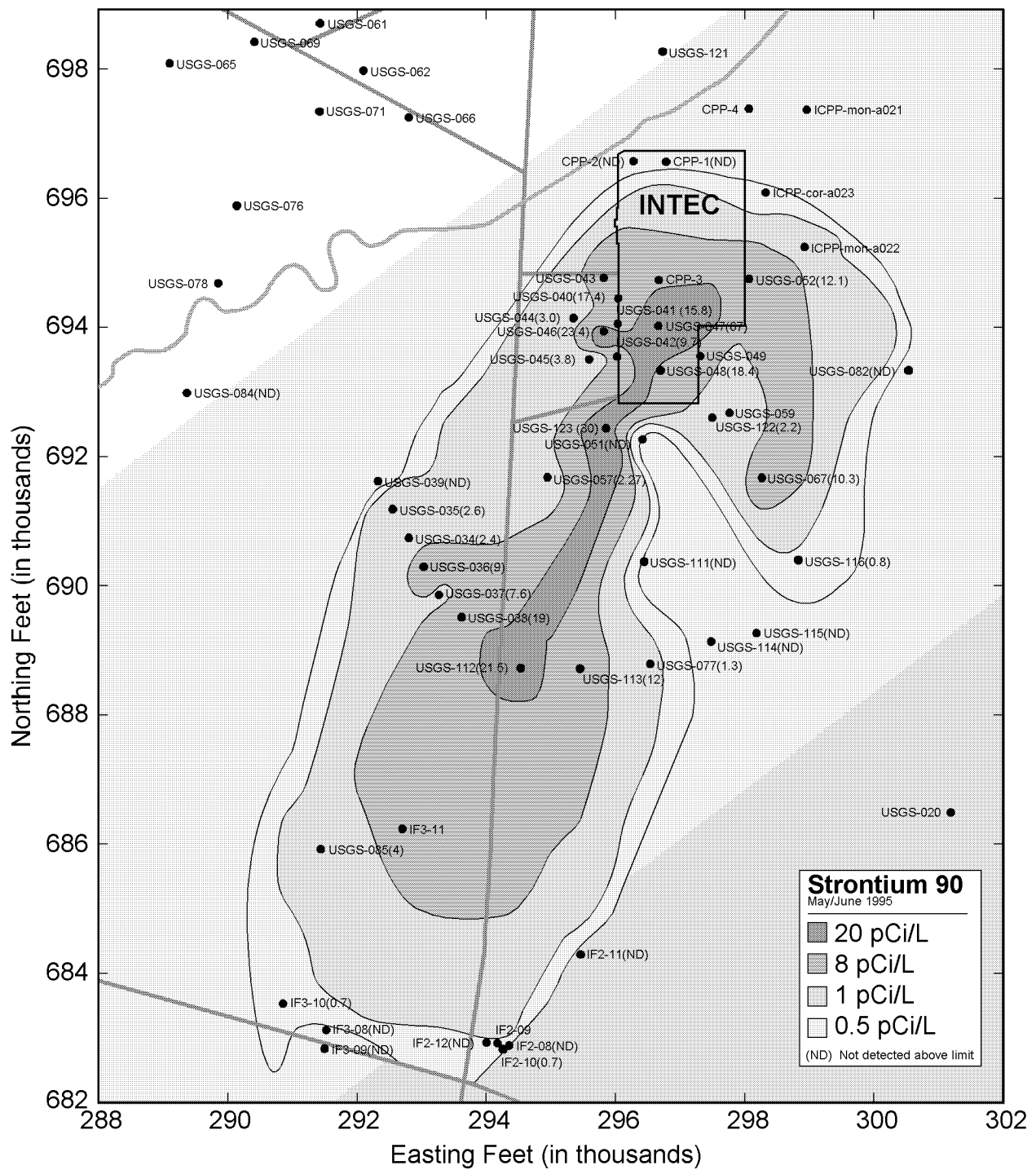
3. Establish SRPA monitoring wells outside of the current INTEC security fence to assess whether MCLs will be exceeded after 2095.

Implementation: This remedy is being implemented through this MSIP and associated work plans. This MSIP details the deepening of four existing SRPA monitoring wells and installation of one new well to sample both the sediments and groundwater of the SRPA above, below, and within the HI (HI is nomenclature for the interbed between the H and I basalt beds as discussed in Anderson 1991) sedimentary interbed in the vicinity of the WAG 3 RI/FS numerical-model-predicted hot spot (that is, the location of highest COC concentrations). It also details groundwater monitoring of existing wells to support the assessment of whether MCLs will be exceeded after 2095. Data collected through these activities will be analyzed to predict whether MCLs will be exceeded after 2095.

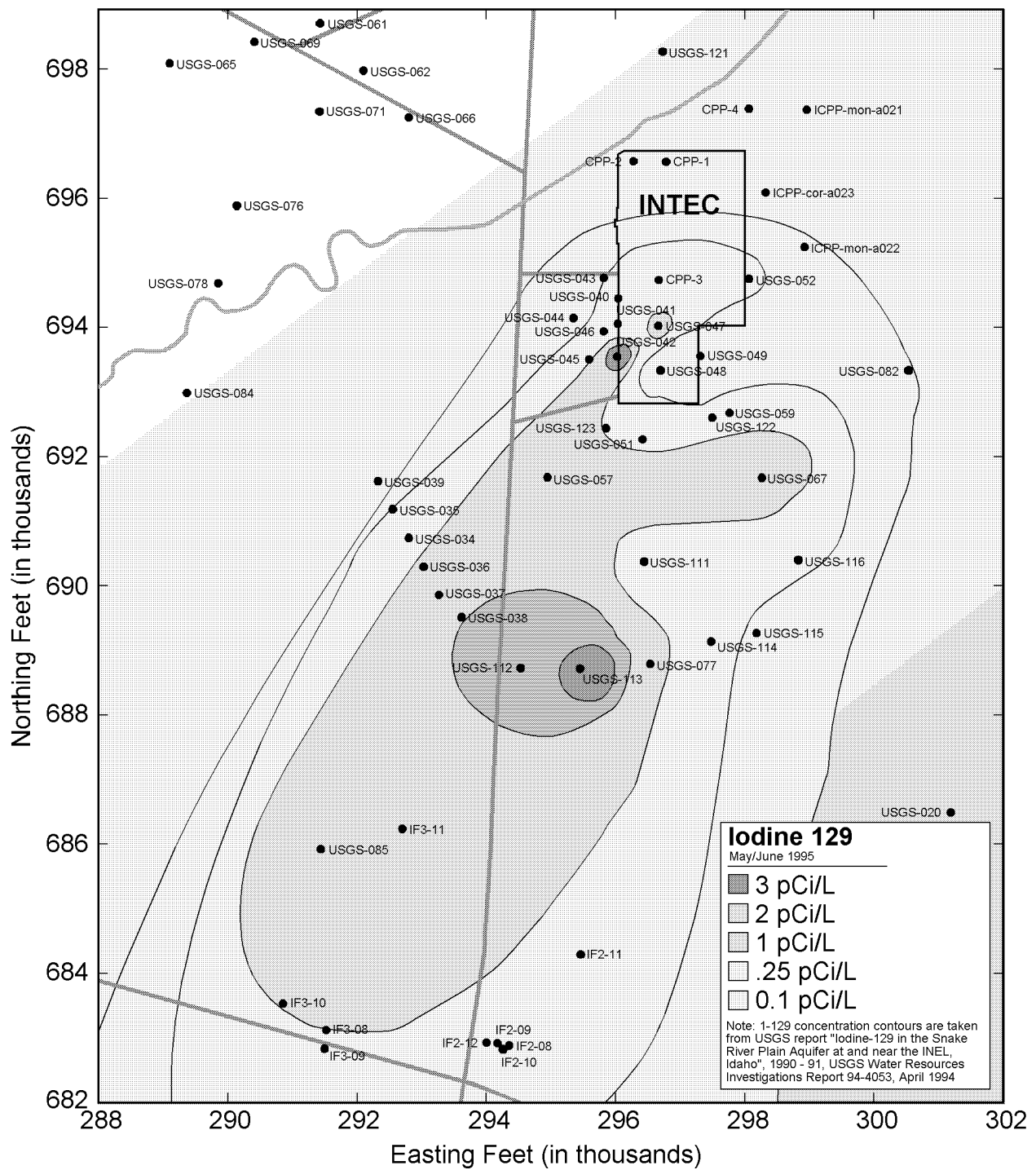


**Figure 1-2.** Contaminant plume showing where tritium (H-3) has been found to exceed standards (May/June 1995).





**Figure 1-3.** Contaminant plume showing where strontium-90 (Sr-90) has been found to exceed standards (May/June 1995).



**Figure 1-4.** Contaminant plume showing where iodine-129 (I-129) has been found to exceed standards (from USGS 1990/1991 data).

4. If observed COC concentrations exceed their action levels at a sustained pumping rate of at least 0.5 gpm for 24 hours, implement pump and treatment RA. Extract contaminated SRPA groundwater from the zone(s) exceeding COC action levels and treat to reduce the contaminant concentrations to meet MCLs by 2095. The action level is the model-predicted maximum concentration that could be present in the year 2000 so that the MCL will not be exceeded in 2095 (the planned end of the institutional control period).

Implementation: Implementation of this remedy is contingent upon the decision obtained under step 3, above. If it is decided that MCLs will not be exceeded in 2095, the contingent pump and treat RA and associated tasks will not be implemented. If it is decided that MCLs will be exceeded in 2095, additional work planning will be conducted to support this RA (see Appendix H).

5. Standard pump and chemical/physical treatment (which may include evaporation in the INEEL CERCLA Disposal Facility (ICDF) Complex surface impoundment) are anticipated to be able to meet the aquifer restoration goal. Conduct treatability studies, which include a technical evaluation of treating the I-129 and other COCs, as part of this remedy. These studies may include evaluation of the ability to treat and selectively withdraw contaminants from the aquifer. These studies have been estimated to not extend more than 12 months and to be limited to a total cost of \$2 million.

Implementation: Implementation of this remedy is contingent upon the decision obtained under step 3, above. If it is decided that MCLs will not be exceeded in 2095, the contingent pump and treat RA and these associated tasks will not be implemented. If it is decided that MCLs will be exceeded in 2095, additional work planning will be conducted to support this RA (see Appendix H).

6. If the treatability studies indicate the presence of sufficient quantities of I-129 and other COCs and contaminated groundwater can be selectively extracted and cost-effectively treated to meet the drinking water MCLs outside the INTEC security fence by 2095, then implement active remediation.

Implementation: Implementation of this remedy is contingent upon the decision obtained under step 3, above. If it is decided that MCLs will not be exceeded in 2095, the contingent pump and treat RA and these associated tasks will not be implemented. If it is decided that MCLs will be exceeded in 2095, additional work planning will be conducted to support this RA.

7. Either return treated water to the aquifer through land recharge in accordance with the Idaho Wastewater Land Application Permit applicable or relevant and appropriate requirements (ARARs) if a recharge impoundment is used or in accordance with National Pollutant Discharge Elimination System (NPDES)/State Pollutant Discharge Elimination System ARARs if the treated effluent is discharged to the Big Lost River, which recharges the aquifer downstream of the INTEC facility; or evaporate in the ICDF Complex evaporation pond or equivalent.

Implementation: Implementation of this remedy is contingent upon the decision obtained under step 3, above. If the decision is reached that MCLs will not be exceeded in 2095, the contingent pump and treat RA and these associated tasks will not be implemented. If it is decided that MCLs will be exceeded in 2095, additional work planning will be conducted to support this RA.

## **1.3 Scope**

The OU 3-13 ROD requires remediation of the SRPA if assessment of the WAG 3 RI/FS model-predicted contaminant hot spot and contaminant concentration trends indicates the concentrations of the Group 5 COCs will exceed MCLs in 2095 and beyond. This work plan and associated documents present the SOW required to evaluate whether contingent RAs are necessary for OU 3-13, Group 5, SRPA.

Two primary activities will be implemented under this MSIP. The first activity is an evaluation of the model-predicted hot spot to check model accuracy and update groundwater model predictions for COC concentrations in 2095 and beyond. The collection of data to support this task is described in detail in Appendix A, the Plume Evaluation Field Sampling Plan (FSP), as well as in Sections 4 and 5 of this report. The second activity comprises (a) groundwater monitoring to evaluate flux of COCs to Group 5 from Group 4 (the INTEC perched water and vadose zone) and the SRPA beneath the INTEC (inside the security fence) and (b) groundwater monitoring of the INTEC plume outside the INTEC fence. The collection of data to support this groundwater COC trend monitoring is discussed in detail in Appendix B, Long-Term Monitoring Plan (LTMP), as well as in Sections 4 and 5 of this report. A brief description of these two activities is provided below.

### **1.3.1 Plume Evaluation FSP Scope**

The basic objective of the Plume Evaluation FSP scope is to evaluate whether the OU 3-13 RI/FS groundwater modeling is accurate in predicting that a hot spot of primarily I-129 exists south of INTEC in the vicinity of wells USGS-111 and USGS-113 that is of sufficient magnitude to exceed MCLs in 2095 and beyond. This will involve deepening and sampling four existing wells and installing of one new well in the vicinity of the model-predicted hot spot to evaluate the occurrence and magnitude of the hot spot. This data will be analyzed to generate a volumetric estimate of the hot spot where concentrations are predicted to exceed MCLs in 2095 and beyond. If a hot spot is not found, this would be an indication that the OU 3-13 RI/FS groundwater modeling predictions are not correct and the model would need to be updated to reflect this finding.

### **1.3.2 Long-Term Monitoring Plan Scope**

The basic objectives of the long-term monitoring actions are to evaluate the contamination in the INTEC groundwater plume outside of the INTEC fence and to evaluate the flux of contaminants into the SRPA outside of the INTEC security fence line (Group 5) from contamination that is currently in the vadose zone and aquifer beneath the footprint of the INTEC facility. These data will be evaluated over time to determine if the flux of COCs into Group 5 will result in exceeding MCLs in 2095 and beyond. This will be accomplished through the long-term periodic sampling and analysis of aquifer monitoring wells in the vicinity of INTEC to track COC concentration trends through the institutional control period.

The wells currently selected for long-term monitoring may be changed based on the results of the baseline sampling and the 5-year review. If additional wells are needed to monitor the SRPA, the LTMP will be revised and a sufficient number of monitoring locations will be chosen to track the groundwater contamination. In addition, the number of wells to be sampled may be expanded every 5 years to allow for evaluation and modifications to the monitoring network.

During the semiannual groundwater sampling event, groundwater samples will be collected using both the high flow (15 – 25 gpm) pumps currently in the wells and using a micropurge method that pumps at approximately 1 gpm at 20 wells. The data from both methods will be evaluated to determine if they

are statistically equivalent and compared to historical data trends. Statistical equivalency will be determined by doing a student t-test on the data.

If the micropurge data are determined to be equivalent to the standard sampling data, future groundwater samples will be collected by this method. Adopting the micropurge method will substantially reduce the amount of waste water generated during sampling and significantly reduce the costs associated with the monitoring program.

### **1.3.3 Other Projects Implementing Remedy Scope**

Other RA elements related to Group 5 are being addressed as projects separate from the SOW of this project. The specific tasks and the projects where they are being handled are as follows:

- Implementation of institutional controls—This work scope is intended to prevent use of perched water while INTEC operations continue and to prevent future drilling into or through the perched zone. This project is being addressed as a part of the Group 8 Institutional Controls Plan.
- Implementation of remedies to control surface water recharge—This work scope is intended to mitigate flux of COCs to the SRPA and Group 5 from the perched water beneath INTEC (inside the security fence), specifically by taking the existing INTEC percolation ponds out of service. The design, construction, and operation of replacement ponds outside the INTEC perched water area following the removal from service of the existing INTEC percolation ponds are being addressed by the OU 3-13 Service Waste Water Discharge Facility project.

### **1.3.4 Composite Analysis Scope**

The WAG 3 RI/FS model did not account for any contaminant sources except soil contamination at Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites. It does not include sources such as the heels that will be left in the tank farm tanks or facility closures. Further the Draft environmental impact statement (EIS) groundwater model includes only high-level waste sources. It does include what is left in the tank heels, but not the contaminated soils around the tanks. The EIS sources and the CERCLA OU 3-13 and OU 3-14 sources all need to be added together to capture all the known sources. Future model runs will consider all sources and the relocation of the percolation ponds.

As part of the CERCLA cumulative risk evaluation, the composite analysis of risks via the groundwater pathway from all sources at INTEC will be updated. As new sites are identified, additional information is obtained about existing sites, and various sites are removed or capped, the WAG 3 aquifer model will be updated to account for the change in source terms.

## **1.4 RD/RA Work Plan Organization**

This MSIP was prepared following the methodology outlined in the *Remedial Design and Remedial Action Guidance for the Idaho National Engineering Laboratory* (DOE-ID 1993) and the requirements outlined in the *Guidance on Expediting Remedial Design and Remedial Action* (EPA 1990). The information developed and presented in this MSIP builds on the decisions made and documented in DOE-ID 2000a and DOE-ID 1999.

The organization of the remainder of this MSIP is as follows:

- Section 2. Design Criteria—Provides a description of the project and the design requirements and provisions.
- Section 3. Design Basis—Provides a status of the OU 3-13 ROD assumptions, a discussion of the modeling of the SRPA hot spot, and an evaluation of how the project ARARs will be met.
- Section 4. Remedial Design—Provides a discussion of the Plume Evaluation FSP and the LTMP design elements.
- Section 5. Remedial Action Work Plan—Provides an overview of the remedial action elements, any changes to the RD/RA SOW, an evaluation of performance measures, and a summation of the key guidance documents.
- Section 6. Reporting—These reports and reviews include CERCLA 5-year reviews and the assessment of the RA performance.
- Section 7. References—Key documents that will be used to guide and direct the execution of the project tasks.

## 2. DESIGN CRITERIA

### 2.1 Group 5 Data Quality Objectives

To help with defensible decision making, the EPA has developed the data quality objective (DQO) process, which is a systematic planning tool, based on the scientific method, for establishing criteria for data quality and for developing data collection designs (EPA 1994). The DQOs presented below have been developed to guide the Group 5 RD/RA. The process consists of seven iterative steps that yield a set of principal study questions and decision statements that must be answered to address a primary problem statement. The seven steps comprising the DQO process are listed below:

- Step 1. State the problem
- Step 2. Identify the decision
- Step 3. Identify the inputs to the decision
- Step 4. Define the study boundaries
- Step 5. Develop decision rules
- Step 6. Specify limits on the decision
- Step 7. Optimize the design for obtaining data.

The DQOs that govern the Group 5 plume evaluation and long-term monitoring are presented separately in the following sections. These objectives were negotiated with, and have the concurrence of, the Agencies.

#### 2.1.1 Plume Evaluation DQOs

The following sections present details on each of the DQO steps to be answered by the work conducted under this FSP. A summary of the HI interbed evaluation DQOs is presented in Table 2-1.

**2.1.1.1 State the Problem.** The WAG 3 ROD (ROD Section 8, page 8-3) established an RAO for the SRPA as follows: “In 2095 and beyond, (to) ensure that SRPA groundwater does not exceed a cumulative carcinogenic risk of  $1 \times 10^{-4}$ , a total, hazard index (HI) of 1; or applicable State of Idaho groundwater quality standards (i.e., MCLs).” Group 5 of WAG 3 is defined as that portion of the SRPA outside of the current INTEC fence line bounded by the contaminant plume that currently exceeds Idaho groundwater quality standards or the federal MCLs for I-129, H-3, and Sr-90. Based upon the above RAO for groundwater, a remediation goal for Group 5 was also established in the ROD (ROD Section 8.1.5, pages 8–10). The remediation goal is to achieve the applicable State of Idaho groundwater standards or risk-based groundwater concentrations in the SRPA plume south of the INTEC security fence by the year 2095.

The ROD also establishes the means of achieving this goal through a phased approach. The first phase would determine if model-derived action levels for COCs are exceeded. The second phase occurs if the action levels are exceeded. In that case, a contingent pumping and treatment action will be implemented to remove sufficient contaminants to facilitate aquifer restoration by 2095 (ROD, Section 8.1.5, pages 8–10). This drilling program is required to determine if current groundwater concentrations for COCs exceed the modeled action levels and, if they do, can sufficient volume and

production rates be achieved by a residential water supply well that would pose a risk to the future groundwater user in the year 2095 and beyond.

Data collected from the drilling program also may be of benefit in the calibration and validation of the present groundwater contaminant predictive model. The model indicates that the principal risk to future groundwater users in the SRPA outside the INTEC facility boundary is the I-129 concentrations in the SRPA (ROD Table 7-8, pages 7–26). From the WAG 3 FSS (DOE-ID 1998) modeling, peak concentrations of I-129 are predicted to remain above MCLs after 2095 in the HI sedimentary interbed while water in the bulk of the aquifer will be below the I-129 MCLs by 2095. However, no empirical data are available to confirm the physical properties of the HI interbed as assumed in the WAG 3 model nor is there any data regarding the presence or absence of high concentrations of I-129 in the interbed. Empirical evidence is required to refine the model predictions and determine whether or not an acceptable risk from I-129 is predicted to exist in 2095 and beyond.

**2.1.1.2 Identify the Decisions.** This step lays out the principal study questions (PSQs), alternative actions (AA), and corresponding decision statements that must be answered to effectively address the above stated problem.

**2.1.1.2.1 Principal Study Questions.** The purpose of the PSQ is to identify key unknown conditions or unresolved issues that, when answered, provide a solution to the problem being investigated, as stated above. The PSQs for this project are as follows:

PSQ-1: Are COC concentration action levels exceeded in the model-predicted hot spot of the groundwater contaminant plume located to the south of the INTEC facility security fence, and do COCs exceed the concentration action levels anywhere vertically within the groundwater contaminant plume located to the south of the INTEC security fence?

PSQ-2: Do any zones that exceed COC action levels identified in PSQ-1 yield a sustained flow of greater than 0.5 gpm for a period of 24 hr?

PSQ-3: Does the hot spot exceed the volume action level such that a residential water user may pump from the hot spot for a period of more than 1 year?

**2.1.1.2.2 Alternative Actions.** AA are those actions that could possibly result from the resolution of the above PSQs. The types of AA considered will depend on the answers to the PSQs.

AA-1: Based on data indicating the degree of contamination, the alternatives to PSQ-1 include proceeding to actions required to define PSQ-2 or to proceed with periodic monitoring.

AA-2: Based on data collected during a 24-hour pumping test, the alternatives to PSQ-2 include proceeding to actions required to define PSQ-3 or to proceed with periodic monitoring.

AA-3: Based on volume determinations, the alternatives to PSQ-3 include proceeding to contingent remediation or proceeding with periodic monitoring.

**2.1.1.2.3 Decision Statements.** The decision statements (DS) combine the PSQ and AA into a concise statement of action. The DS for each of the PSQs is stated below.

DS-1: Determine whether COC concentration action levels are exceeded in the model-predicted hot spot downgradient of INTEC, requiring additional evaluation of the aquifer water yield from the hot spot.



Table 2-1. Data quality objectives table for OU 3-13, Group 5, Snake River Plain Aquifer.

Problem Statement A: HI Interbed Contingent Remedy Decision				
1: State the Problem	2: Identify the Decision	Alternative Actions	Decision Statement	3: Identify Inputs to the Decision
<p>Problem Statement A: Empirical data are required to support refinement of the WAG 3 Snake River Plain Aquifer numerical model to determine if, following model refinement, we continue to predict a risk to future groundwater users post-2095 due to I-129 potentially present in the HI sedimentary interbed.</p> <p>Note: Modeling of the Snake River Plain Aquifer for the WAG 3 RI/FS predicted a future risk to groundwater users due to high concentrations of I-129 predicted to be present in the low-hydraulic conductivity HI sedimentary interbed in the year 2095 and beyond. However, no empirical data are available to confirm the physical properties of the HI interbed as assumed in the WAG 3 model nor is there any data regarding the presence or absence of high concentrations of I-129 in the interbed. Empirical evidence is required to refine the model predictions and determine whether or not an acceptable risk from I-129 is predicted to exist post-2095.</p>	<p>PSQ-1: Are COC concentration action levels exceeded in the model-predicted hot spot of the groundwater contaminant plume outside of the INTEC security fence?</p> <p>Note: The action level(s) is based on groundwater modeling and will correspond to COC concentrations that will not exceed risk concentrations greater than <math>1 \times 10^{-4}</math> or MCLs in the year 2095. COC concentration data will be obtained from the HI interbed and surrounding basalts during the field sampling program anticipated to occur in FY 2001. Modeling predictions are required to determine if these action levels will be exceeded in 2095. The combined COC action level for H-3, Sr-90, and I-129 (beta -gamma-emitters) is 4 mrem/yr in the year 2095.</p>	<p>AA-1: Alternatives to PSQ-1 include proceeding on to actions required to answer PSQ-3 or lapsing into Snake River Plain Aquifer monitoring.</p>	<p>DS-1: Determine whether COC concentration action levels are exceeded in the model-predicted hot spot downgradient of INTEC requiring additional evaluation of the aquifer water yield from the hot spot.</p>	<p>The inputs to PSQ-1 are:</p> <ul style="list-style-type: none"><li>Groundwater model sensitivity analysis of the HI sedimentary interbed characteristics to identify key variables related to HI interbed for long-term predictions of COC concentrations.</li><li>Deepening of four aquifer wells and installation of one new well in the vicinity of the model-predicted I-129 hot spot for groundwater and sedimentary interbed sampling.</li><li>Physical characteristics of the HI sedimentary interbed, (identified in the aquifer model sensitivity analysis), to support model refinement and COC concentration predictions.</li><li>Borehole geophysical and fluid logging of four deepened wells, three existing wells, and one new well for location of sampling depths.</li><li>Vertical profile sampling (straddle packer) of a new well, four deepened wells, and three existing wells for COC concentrations at, above, and below the HI interbed.</li><li>A baseline sampling round of 47 aquifer monitoring wells for I-129, H-3, and Sr-90 to support model refinement and COC concentration predictions.</li><li>Model refinement and updated prediction of COC concentrations in 2095 and beyond.</li></ul>
	<p>PSQ-2: Do zones which exceed COC action levels identified in PSQ-1 yield a sustained flow of greater than 0.5 gpm for a period of 24 hr?</p>	<p>AA-2: Alternatives to PSQ-2 included proceeding to actions required to answer PSQ-3 or lapsing into Snake River Plain Aquifer monitoring</p>	<p>DS-2: Determine if the hot spot will yield a groundwater flow rate of 0.5 gpm for a period of 24 hr.</p>	<p>If the COC action levels are exceeded in PSQ-1, then the inputs to PSQ-2 will be:</p> <ul style="list-style-type: none"><li>A 24-hour/0.5-gpm pumping test(s) of the zones which were identified in PSQ-1 as having COC(s) which exceeded action level(s)</li><li>Sampling of the COC(s) during the pumping test.</li></ul>
	<p>PSQ-3: Does the hot spot exceed the volume action level such that a residential water user may pump from the hot spot for a period of more than 1 year?</p>	<p>AA-3: Alternatives to PSQ-3 include proceeding on to the contingent remedy and aquifer monitoring or just lapsing into Snake River Plain Aquifer monitoring.</p>	<p>DS-3: Determine if the hot spot is of sufficient size/volume to require contingent remediation.</p>	<p>If required, the inputs to PSQ-3 will be:</p> <ul style="list-style-type: none"><li>An analytical or model-derived volume action level.</li><li>Evaluation of the COC hot spot volume through the creation of iso-surface maps to calculate the estimated volume.</li></ul>
4. Define the Study Boundaries				
<p>This study will focus on physical characteristics of the HI sedimentary interbed and peak concentrations and distribution of groundwater COCs within the Snake River Plain Aquifer groundwater contaminant plume south of INTEC. The purpose of the study is to determine if the WAG 3 RI/FS aquifer model is correct in predicting that there will be an unacceptable risk to residential groundwater users outside of the INTEC fence line in excess of <math>1 \times 10^{-4}</math> (or COCs exceeding MCLs) in the year 2095 and beyond. The potential risk is primarily from I-129, which is predicted by the aquifer model to reside in the HI interbed at concentrations exceeding the remediation goal.</p> <p>The spatial boundary of this study is limited to the area defined as Group 5, Snake River Plain Aquifer, under the OU 3-13 ROD. This encompasses that portion of the Snake River Plain Aquifer outside of the INTEC security fence bounded by the groundwater contaminant plume that exceeds Idaho groundwater quality standards of the federal MCLs for I-129, H-3, or Sr-90. Based upon the WAG 3 groundwater model, the area of particular interest within this boundary is an I-129 hot spot south of INTEC in the vicinity of well USGS-113 (Note: this may be refined by prefield testing sensitivity analysis of HI interbed in the WAG 3 aquifer model). The estimated depth of the HI interbed in this area is between 100 and 140 ft below the water table, though the aquifer above, within, and below the HI interbed is included in this study. The base of the study area will be the first high permeability zone in the I basalt below the HI interbed, but not to exceed 100 ft below base of HI interbed. The hot spot is predicted to exist within the HI sedimentary interbed below the water table at this location. However, to date, empirical evidence has not been collected that supports the existence of this hot spot, nor has a sensitivity analysis been performed on the WAG 3 model's representation of the HI interbed that resulted in the prediction. It should be noted that practical constraints on the collection of soil and groundwater samples (i.e., poor sample recovery, limitation on packer deployment in rubblely or cavernous zones, etc.) may limit our ability to sample the interbed or SRPA in general at certain zones.</p> <p>This study will be used to determine if contingent groundwater remediation is required to reduce the risk to future groundwater users in the year 2095 and beyond. Thus the current decision of whether or not to implement the contingent remedy will rely on predicted concentrations of COCs as calculated by the refined WAG 3 aquifer model. Prior to 2095, institutional controls will be in place to prevent residential use of groundwater exceeding MCLs or <math>1 \times 10^{-4}</math> risk concentrations.</p>				

Table 2-1. (continued).

Problem Statement A: HI Interbed Contingent Remedy Decision			
5: Develop a Decision Rule	6: Specify Tolerable Limits on Decision Errors	7: Optimize the Design	
DS-1: If any COC exceeds its action level at any sampling zone, then we must determine if the aquifer at that zone is also capable of producing a sustained yield of 0.5 gpm for a period of 24 hr. If COC action levels are not exceeded at any sampling location then we will proceed with Snake River Plain Aquifer monitoring (i.e., periodic monitoring).	To be determined.	<p>A flow chart presenting the conceptual design of the WAG 3 Group 5 field activities is attached as Figure 2-1 titled "Project flow chart showing conceptual design of field activities." The flow chart details the steps to be taken to both arrive at a contingent remedy decision and to perform the SRPA interim monitoring. The two separate flow paths are identified on the chart. The following paragraphs describe and present the rationale for the design of field activities related to the contingent remedy decision.</p> <p>The Group 5 decision to collect additional COC concentration and SRPA and interbed data prior to making a decision on implementation of the contingent remedy is based upon the need to evaluate the WAG 3 RI/FS model predictions of elevated I-129 concentrations in the SRPA, including the HI interbed, post-2095. Because no physical characteristics or COC concentration data were available from the HI interbed to confirm the model predictions and no sensitivity analysis has been performed, we must collect empirical data on the presence of I-129 in the SRPA and physical properties of the HI interbed south of INTEC to support refinement of the groundwater model. Given the basis for the field activities, prior to conducting the field activities, available field data will be reviewed and a sensitivity analysis on the HI interbed assumptions will be performed. This activity will be performed to identify hydrologic data gaps which will be incorporated in the final sampling and analysis plan for the Group 5 contingent remedy decision. This work will also be used to refine the predicted I-129 hot spot location, select existing wells for sampling (if any) and to determine if additional wells are required and their locations.</p> <p>Based upon the evaluation of the RI/FS modeling results and existing data, one new well location has been selected (south of USGS-112 and USGS-113) and four existing USGS wells will be deepened in the vicinity of the predicted I-129 hot spot. The wells will be drilled in a manner that allows for the collection of sedimentary interbed samples from the HI interbed for analysis of physical characteristics and COC concentrations. Following drilling, borehole geophysical and fluid logging will be performed on the newly deepened wells (and three existing wells selected for profiling) to identify sampling locations for COC vertical profile sampling. The geophysical logging will consist of natural gamma, caliper, deviation, and video logging. Borehole fluid logging will consist of borehole flow, temperature, and specific conductivity. These logs will be reviewed prior to groundwater sample collection to identify the specific zones within each borehole for sampling.</p> <p>Groundwater sampling will be conducted using a packer system and sampling pump to isolate the specific zone being sampled. Except for the interbed sampling, one sample will be collected from each sampling zone. Because of concerns about borehole collapse or sloughing in the interbed, groundwater samples from the interbed will be collected during drilling. The borehole will be extended approximately 5 ft into the interbed and the first sample will be taken The total depth of the former injection well was 598 ft. Accordingly the base of the study boundary should correspond to the total depth of injection, or approximately yard against equipment getting trapped in the hole, the pump will be placed above the packer and a screen placed below the packer in the interbed. Replicate samples for Tc-99 and I-129 will be collected during interbed sampling. The replicate Tc-99 samples will be analyzed and the replicate I-129 sample held in storage until the results are determined for the I-129 and Tc-99 samples. The replicate samples will be analyzed for Tc-99 to confirm the original sample results. If I-129 is above the action level, the replicate I-129 sample from the interbed will be analyzed. An aquifer stress test, a slug test, will also be performed at the time of sampling.</p> <p>Following sample collection and analysis, the data will be reviewed to determine if the COC action level is exceeded in any sampling zone. If the COC action level is exceeded in a zone, the zone will again be isolated with packers and pumped for a period of 24 hr to determine if the zone will yield groundwater at a rate of 0.5 gpm for the duration of the test. One water sample will be collected every 4 hours during pumping to determine if the COC action levels are also exceeded throughout the pumping test.</p> <p>If COC action levels are exceeded and the aquifer at the sampling zone(s) yields a sustained 0.5 gpm for a 24-hr period, isopleth maps will be developed from the COC concentration data to estimate the volume of the hot spot(s). It is possible that additional wells may be required estimate the hot spot volume. If additional wells are determined necessary, they will be drilled and then tested in the same manner as described above. The final volume estimates will be compared to the model-derived volume action level to determine if it has been exceeded. These results will be reported in the Group 5 monitoring report/decision summary.</p> <p>To assist in the model evaluation and COC predictions discussed above, and to up date information on COC plume dynamics subsequent to the 1991 USGS sampling event, samples will be collected from the existing aquifer monitoring well network and analyzed for COC concentrations. This sampling will provide additional data to support model predictions of how the aquifer is performing outside of the HI interbed and support refining of the model predictions. A first round of sampling will be performed including the full INTEC monitoring network (47 wells), with subsequent annual monitoring performed on a limited set of wells (approximately 20) specifically identified to support an updated aquifer model calibration.</p> <p>Following completion of the monitoring report/decision summary, periodic monitoring of the WAG 3 groundwater plume(s) outside of the INTEC security fence line will be implemented. This periodic monitoring of the plumes will be performed concurrent with the INTEC facility monitoring.</p>	
DS-2: If the aquifer is capable of producing 0.5 gpm for a period of 24 hr from a zone which also exceeds COC action levels, then we must determine the volume of the hot spot. If the zone does not produce 0.5 gpm for 24 hr then we will proceed with Snake River Plain Aquifer monitoring.			
DS-3: If the volume of the COC hot spot is sufficiently large that a future groundwater user could pump from the hot spot for a period of more than 1 year then we are required to proceed with the contingent remedy. If the hot spot does not exceed the volume action level then we will proceed with Snake River Plain Aquifer monitoring.			

Table 2-1. (continued).

Problem Statement B: INTEC Facility Monitoring					4. Define the Study Boundaries
1: State the Problem	2: Identify the Decision		3: Identify Inputs to the Decision		
	Principal Study Questions	Alternative Actions	Decision Statement		
<p>Problem Statement B: Monitor the flux of contaminants in the aquifer across the INTEC security fence line and downgradient of the facility to determine if the Group 5 RAO of achieving Idaho groundwater quality standards or risk-based concentrations by 2095 will be affected by contamination within the INTEC facility.</p> <p>OU 3-13 Group 5 is defined as the portion of the SRPA outside of the INTEC security fence where concentrations of COCs exceed current MCLs or for OU 3-13, Group 5, is “Achieving the applicable State of Idaho groundwater standards or risk-based groundwater concentrations in the SRPA plume south of the INTEC security fence by the year 2095” (ROD, Section 8.1.5, pages 8—10). To determine if this goal will be met, the input of contaminants to Group 5 from the contaminated aquifer within the INTEC security fence must be determined.</p>	PSQ-1: Is the COC flux in the SRPA from the contaminated media in the vadose zone beneath the INTEC facility of sufficient magnitude to prevent achieving the Group 5 remediation goals?	No alternative actions required for monitoring program	DS-1: Determine whether or not the flux of contaminants in the SRPA which originate in the vadose zone within the INTEC security fence line is of sufficient magnitude to exceed the Group 5 remediation goals in 2095.	The inputs to PSQ-1 are: <ol style="list-style-type: none"><li>1. Sampling of selected wells upgradient of, near the boundary of, and within the INTEC security fence line and analysis for COCs. Selected wells will be sampled in the upper 50 ft of the SRPA.</li><li>2. Measurement of water table elevations for evaluation of groundwater elevation contours and flow direction.</li><li>3. Periodic incorporation of new data and update of the WAG 3 OU 3-13 aquifer numerical model for prediction of COC concentrations in the SRPA at 2095 and beyond.</li></ol>	<p>This study will focus on the SRPA beneath the INTEC facility and near the boundary of the facility. The area of focus along the INTEC boundary is the south and west boundaries given the south-southwest direction of groundwater flow in this region.</p> <p>The primary sources of contaminants to the aquifer include both the perched water/vadose zone above SRPA and the former injection well which penetrates the aquifer and HI interbed. Two principal study questions have been identified to evaluate these sources separately.</p> <p>The portion of the aquifer that is likely to be affected by contaminants transported through the vadose zone is the upper 50 ft of the aquifer above the HI interbed.</p>
	PSQ-2: Is the COC flux in the SRPA from the contaminated sediments/sludges remaining in the former ICPP injection well (CPP-23) and immediate vicinity of sufficient magnitude to prevent achieving the Group 5 remediation goal?	No alternative actions required for monitoring program.	DS-2: Determine whether or not the flux of contaminants in the SRPA from the former INTEC injection well is of sufficient magnitude to exceed the Group 5 remediation goals in 2095.	The inputs to PSQ-2 are: <ol style="list-style-type: none"><li>1. Borehole geophysical and fluid logging of selected wells which penetrate the HI interbed for selection of wells and sampling zones below the HI interbed for selection of wells and sampling zones below the HI interbed downgradient of the former injection well.</li><li>2. Isolation through packers or other method(s), sampling, and analysis for COCs of selected well zones below the HI interbed downgradient of the former injection well.</li><li>3. Measurement of water table elevations for evaluation of groundwater elevation contours and flow directions, and possibly head gradient between aquifer above and below the HI interbed.</li><li>4. Periodic incorporation of new data and update of the WAG 3 OU 3-13 aquifer numerical model for prediction of COC concentrations in the SRPA at 2095 and beyond.</li></ol> <p>Note: Isolation of sampling zone(s) beneath the HI interbed depth from selected wells should not preclude also sampling of zone(s) above the HI interbed from the same well to supply inputs for PSQ-1.</p>	<p>Because the former injection well penetrated the HI interbed, the portion of the aquifer potentially affected by the injection well includes both the upper zone from the water table to the HI interbed and the lower zone beneath the HI interbed. The total depth of the former injection well was 598 ft. Accordingly the base of the study boundary should correspond to the total depth of injection, or approximately 600 ft below land surface.</p> <p>Monitoring the concentrations of COCs above and below the HI interbed and as far downgradient as indicated by the detections of COCs above MCLs.</p> <p>Because the remediation goal is established in the year 2095, this study will continue through the institutional control period to at least 2095.</p>
	PSQ-3: Are the COC concentrations in the SRPA outside the INTEC facility at sufficient magnitude to prevent achieving the Group 5 remediation goals?	No alternative actions required for monitoring program.	DS-3: Determine whether or not the COCs in the SRPA outside the INTEC facility will exceed the Group 5 remediation goals in 2095.	The inputs to PSQ-3 are: <ol style="list-style-type: none"><li>1. Sampling of selected wells downgradient of the INTEC security fence and analysis for COCs. Selected wells will monitor contaminants above MCLs and monitor the downgradient plume area above MCLs.</li><li>2. Measurement of water elevations for evaluation of groundwater elevation contours and flow direction.</li><li>3. Periodic incorporation of new data into the OU 3-13 aquifer numerical model for the predication of COC concentrations in the SRPA in 2095 and beyond.</li></ol>	

Table 2-1. (continued).

Problem Statement B: INTEC Facility Monitoring															
5: Develop a Decision Rule	6: Specify Tolerable Limits on Decision Errors	7: Optimize the Design													
<p>If the monitoring activities and model predictions generated for this study indicate that Group 5 RAOs/remedial goals will be exceeded due to the flux of contaminants in the SRPA beneath or downgradient of the INTEC facility, a comprehensive evaluation, focused feasibility study, and ROD amendment will be performed to address the risks posed by groundwater contaminants beneath INTEC and/or downgradient of INTEC. If it is determined that the RAOs/remedial goals will be met, monitoring will continue until 2095 or until the agencies determine that no unacceptable risk exists from Group 5.</p> <p>Note: The decision is based upon model predictions using data obtained from an observational well network to model evolution of the plume.</p>	<p>In this case, the decisions will be made by comparing data to computer predictions, the accuracy of the computer predictions will be dependent on the accuracy of the OU 3-13 model</p>	<p>A flow chart presenting the conceptual design of the WAG 3 Group 5 field activities entitled “Project flow chart showing conceptual design of field activities,” is shown in Section 2, Figure 2-1. The flow chart details the steps to be taken to both arrive at a contingent remedy decision and to perform the SRPA interim monitoring. The two separate flow paths are identified on the chart. The following paragraphs describe and present the rationale for the design of field activities related to the contingent remedy decision.</p> <p>Thirty-six wells are available in the vicinity of INTEC suitable for groundwater monitoring. From that set of wells, 11 are selected for the INTEC facility monitoring program to support PSQ-1, monitoring of the contaminant input from the vadose zone to the SRPA. The PSQ-1 INTEC facility monitoring shall consist of groundwater sample collection from wells located upgradient of, within, and adjacent to the INTEC facility. The wells selected for monitoring include MW-18, USGS-40, USGS-42, USGS-47 through -49, USGS-51, USGS-52, and USGS-122 through USGS-123 (see Section 4, for a figure showing well locations). One well, USGS-121, was selected upgradient of the contaminant source areas at INTEC to provide background groundwater quality data. Though this well is not directly upgradient of the INTEC facility, it is located nearer to the groundwater flow paths from potential sources of upgradient contamination (TRA or NRF) than other wells and is, in that respect, well suited for providing upgradient water quality data. Several wells were selected inside the INTEC facility (MW-18, USGS-47, USGS-48, USGS-49, and USGS-52) to help distinguish between the possible sources of groundwater contaminants located throughout the INTEC facility. Wells USGS-40, USGS-42, USGS-51, USGS-122, and USGS-123 were selected because they are located along the southern and western boundaries of INTEC. The general direction of groundwater flow beneath INTEC is interpreted to be to the south-southwest. The selected wells are considered adequate for the INTEC facility monitoring and no new wells are considered necessary at this time. However, additional wells are currently planned for various other monitoring programs at INTEC. As these wells become available, they will be considered for inclusion into the INTEC facility monitoring program.</p> <p>The three wells selected for monitoring in support of PSQ-2, former injection well monitoring, are USGS-41, USGS-48, and USGS-59 based upon an evaluation of their suitability for monitoring the aquifer below the HI interbed. There are 12 USGS wells in the vicinity of INTEC and the former injection well that penetrate the HI interbed and remain as open boreholes in the aquifer, potentially suitable for long-term monitoring of the aquifer beneath the HI interbed (excluding INTEC production wells which are required for facility support and cannot be modified to sample below the HI interbed). The wells are USGS-40 through-49, USGS-51, USGS-52, and USGS-59. These wells are located either cross-gradient or downgradient of the former injection well. An evaluation of available data from and additional geophysical and borehole fluid logging of these wells will be performed to determine if they are suitable for deep sampling and to identify potential zones for sampling. It should be noted that an upgradient monitoring well which penetrates the HI interbed is not available within the existing monitoring well network at INTEC. Well USGS-121 does not penetrate the HI interbed. Production wells CPP-1, CPP-2, and CPP-4 have been drilled through the HI interbed and have perforated well casing both above and below the HI interbed but are of limited use as monitoring wells based upon their required support of INTEC operations. The need for an upgradient monitoring well in this zone will be evaluated after the monitoring program is initiated. If the data obtained from the facility monitoring program indicate that the injection well secondary source may cause or contribute to not meeting the Group 5 RAO/ remediation goals, an upgradient well will be installed for sampling beneath the HI interbed to ensure that an upgradient source is not present. It should also be noted that current plans for OU 3-14 investigation include the installation of monitoring well in the immediate vicinity of the former injection well. As these well(s) become available, they will be incorporated into the INTEC facility monitoring well program to provide additional data in the vicinity of the injection well secondary source.</p> <p>In addition to the above monitoring, one sampling round will be conducted using the entire INTEC monitoring network at the onset of the activities outlined in the LTMP. This sampling event will provide a “snapshot” of the current state of the contamination of the SRPA in the vicinity of the INTEC facility and provide a data set to compare the COC flux monitoring data. In addition, these data will be used to update the OU 3-13 numerical aquifer model. In support of Group 4 activities, groundwater samples collected during the baseline sampling event from USGS-40, -42, -47, -48, -49, -51, -121, -122, -123, and MW-18 will be analyzed for stable isotopes including oxygen, hydrogen, and nitrogen. In addition to the analytes listed below, metals and anions will be included in the semiannual and micropurge sampling.</p> <p>Six wells have been selected for long-term monitoring of the INTEC plume beyond the facility boundary in support of PSQ-3. The wells selected for long-term monitoring are USGS-57, USGS-67, USGS-112, USGS-113, USGS-85, and LF3-08. These wells were selected based on a review of the historical data for I-129. However, most of the data used to select these wells for long-term monitoring is from 1990–1991; therefore, the baseline groundwater sampling data will be used to optimize the well locations and the total number of wells for long-term monitoring.</p> <p>Analytes of interest include COCs which currently exist in the SRPA at concentrations exceeding either MCLs or risk-based concentrations as well as COCs derived from the modeling which are predicted to potentially cause a future unacceptable risk to the SRPA. Contaminants that currently exceed MCLs or risk-based concentrations and will be included in the INTEC facility monitoring program are I-129, H-3, and Sr-90. Contaminants that are predicted by the WAG 3 RI/FS modeling to exceed MCLs or risk-based concentrations at a future date and are included in the INTEC facility monitoring program are plutonium and uranium isotopes, Np-237, Am-241, and mercury. Chromium, while listed as a COC, is excluded because it is specifically related to groundwater contamination at TRA. Also, because Tc-99 is a contributor to total beta-emitting radionuclides limit and present at significant concentrations in the aquifer beneath INTEC, it is included in the list of analytes for INTEC facility monitoring. To evaluate additional radionuclides that may be present but not accounted for in the modeling, gross-alpha and gross-beta analyses will also be performed. Finally, the list of analytes will be updated through either the exclusion of some analytes or inclusion of additional analytes as analytical data are accumulated or new information regarding contaminant sources is identified. The detection limits for I-129, Sr-90, and tritium required to make the decisions needed concerning the contingent remedy are 0.1 pCi/L, 0.8 pCi/L and 2000 pCi/L, respectively.</p> <p>Sampling and analyses will occur at the following frequency:</p> <table><tr><td>Year 1</td><td>Baseline and Semiannual</td><td>Gross-alpha/beta, Hg, tritium, Tc-99, I-129, Sr-90, plutonium isotopes (Pu-238, -239, -240, and –241), uranium isotopes (U-234, -235, and -238), Am-241, Np-237, Cs-137; metals and anions in semiannual and micropurge sampling only.</td></tr><tr><td>Years 2–7</td><td>Annual</td><td>Gross-alpha/beta, Hg, tritium, Tc-99, I-129, Sr-90, plutonium isotopes (Pu-238, -239, -240, and –241), uranium isotopes (U-234, -235, and –238), Am-241, Np-237, Cs-137</td></tr><tr><td>Years 8–16</td><td>Biannual (once every two years)</td><td>Review and adjust as required</td></tr><tr><td>Years 17–100</td><td>Once every 5 years</td><td>Review and adjust as required</td></tr></table> <p>Following each sampling event and prior to each CERCLA 5-year review, the new groundwater sampling results will be compared against the OU 3-13 aquifer model predictions to determine if concentrations are above, at, or below the model-predicted trends. If the new data indicate the model must be updated, the model will be updated generating new COC concentration predictions. These predictions will be compared against the Group 5 RAO/ remediation goals to determine if they will be exceeded or not. If the data trends exceed model-predicted trends and indicate a potential exceedance of the Group 5 RAO/remediation goals, the sampling frequency will revert to annual sampling and progress in a manner similar to the schedule above.</p>	Year 1	Baseline and Semiannual	Gross-alpha/beta, Hg, tritium, Tc-99, I-129, Sr-90, plutonium isotopes (Pu-238, -239, -240, and –241), uranium isotopes (U-234, -235, and -238), Am-241, Np-237, Cs-137; metals and anions in semiannual and micropurge sampling only.	Years 2–7	Annual	Gross-alpha/beta, Hg, tritium, Tc-99, I-129, Sr-90, plutonium isotopes (Pu-238, -239, -240, and –241), uranium isotopes (U-234, -235, and –238), Am-241, Np-237, Cs-137	Years 8–16	Biannual (once every two years)	Review and adjust as required	Years 17–100	Once every 5 years	Review and adjust as required	
Year 1	Baseline and Semiannual	Gross-alpha/beta, Hg, tritium, Tc-99, I-129, Sr-90, plutonium isotopes (Pu-238, -239, -240, and –241), uranium isotopes (U-234, -235, and -238), Am-241, Np-237, Cs-137; metals and anions in semiannual and micropurge sampling only.													
Years 2–7	Annual	Gross-alpha/beta, Hg, tritium, Tc-99, I-129, Sr-90, plutonium isotopes (Pu-238, -239, -240, and –241), uranium isotopes (U-234, -235, and –238), Am-241, Np-237, Cs-137													
Years 8–16	Biannual (once every two years)	Review and adjust as required													
Years 17–100	Once every 5 years	Review and adjust as required													

DS-2: Determine if the hot spot will yield a groundwater flow rate of 0.5 gpm for a period of 24 hours, requiring additional evaluation of the aquifer water hot spot volume.

DS-3: Determine if the hot spot is of sufficient size/volume to require contingent remediation. This step identifies the informational inputs that are required to answer the DS made above.

#### **2.1.1.2.4 Inputs for PSQ-1.**

1. Groundwater model sensitivity analysis of the HI sedimentary interbed characteristics to identify key variables related to HI interbed for long-term predictions of COC concentrations.
2. Four existing wells will be deepened and one new aquifer well installed in the vicinity of the model-predicted I-129 hot spot for groundwater and sedimentary interbed sampling.
3. Physical characteristics of the HI sedimentary interbed (saturated hydraulic conductivity, bulk density, grain size, distribution, and porosity estimate) will be identified in the aquifer model sensitivity analysis to support model refinement and COC concentration predictions.
4. Borehole geophysical and fluid logging of four deepened wells, three existing wells, and one new well for location of sampling depths.
5. Vertical profile sampling (straddle packer) of four deepened wells, three existing wells, and one new well for I-129, H-3, and Sr-90 concentrations at, above, and below the HI interbed.
6. A baseline sampling round of 47 aquifer monitoring wells for I-129, H-3, and Sr-90 to support model refinement and COC concentration predictions.
7. Model refinement and updated prediction of COC concentrations in 2095 and beyond.

**2.1.1.2.5 Inputs for PSQ-2.** If the COC action levels are exceeded in PSQ-1, then a pumping test will be conducted to determine if the hot spot zone will yield groundwater at a rate of 0.5 gpm for a period of 24 hours. The zone(s) exceeding action levels as determined by sampling performed for PSQ-1 will be pump-tested for a 24-hour period. During the pumping test, discharge water will be sampled to determine if COC concentrations exceed the action level throughout the pumping period. Thus, the inputs for PSQ-2 are

1. A 24-hour/0.5-gpm pumping test(s) of the zones that were identified in PSQ-1 as having COC(s) that exceeded action level(s)
2. Sampling of the discharge water for COC(s) during the pumping test.

**2.1.1.2.6 Inputs for PSQ-3.** If the results of studies performed for PSQ-1 and PSQ-2 indicate that further action is necessary, PSQ-3 will be implemented to determine what the volume of the hot spot(s) is and whether the volume of the hot spot will sustain pumping for a period of 1 year. The volume action level will need to be determined based upon either analytical or numerical modeling techniques. Three-dimensional isopleth maps will be prepared from this information to estimate the volume of the hot spot that exceeds the COC action levels. Therefore, if required, the inputs to PSQ-3 will be

1. An analytical or model-derived volume action level
2. Evaluation of the COC hot spot volume through the creation of iso-surface maps to calculate the estimated volume.

**2.1.1.3 Define the Boundaries of the Study.** This study will focus on physical characteristics of the HI sedimentary interbed and peak concentrations and distribution of groundwater COCs within the SRPA groundwater contaminant plume south of INTEC. The purpose of the study is to determine if the WAG 3 RI/FS aquifer model is correct in predicting that there will be an unacceptable risk to residential groundwater users outside the INTEC fence line in excess of  $1 \times 10^{-4}$  or COCs exceeding MCLs in the year 2095 and beyond. The potential risk is primarily from I-129, which is predicted by the aquifer model to reside in the HI interbed at concentrations exceeding the remediation goal.

The spatial boundary of this study is limited to the area defined as Group 5, SRPA, under the OU 3-13 ROD. This encompasses that portion of the SRPA outside the INTEC security fence bounded by the groundwater contaminant plume that exceeds Idaho groundwater quality standards and the federal MCLs for I-129, H-3, or Sr-90. Based upon the WAG 3 groundwater model, the area of particular interest within this boundary is an I-129 hot spot south of INTEC in the vicinity of USGS-113 Well. The estimated depth of the HI interbed in this area is between 30 and 43 m (100 and 140 ft) below the water table, though the aquifer above, within, and below the HI interbed is included in this study. The base of the study area will be the first high permeability zone in the I basalt below the HI interbed, but not to exceed 30 m (100 ft) below base of HI interbed. The hot spot is predicted to exist within the HI sedimentary interbed below the water table at this location. However, to date, empirical evidence has not been collected that supports the existence of this hot spot, nor has a sensitivity analysis been performed on the WAG 3 model of the HI interbed that resulted in the prediction.

It should be noted that practical constraints on the collection of soil and groundwater samples (i.e., poor sample recovery, limitations on packer deployment in highly fractured or cavernous zones, etc.) may limit our ability to sample the interbed or SRPA at certain zones. This study will be used to determine if contingent groundwater remediation is required to reduce the risk to future groundwater users in the year 2095 and beyond. Thus, the current decision of whether to implement the contingent remedy will rely on predicted concentrations of COCs as calculated by the refined WAG 3 aquifer model.

Prior to 2095, institutional controls will be in place to prevent residential use of groundwater exceeding MCLs or  $1 \times 10^{-4}$  risk concentrations.

**2.1.1.4 Develop a Decision Rule.** This step brings together the outputs from Steps 1 through 4 into a single statement describing the basis for choosing among the listed alternatives. The decision rules guiding this investigation are basically set forth in Figure 11-6, on page 11-24 of the WAG 3 ROD (DOE-ID 1999). Three criteria must be met prior to a positive decision to implement contingent remediation:

Decision Rule (DR)-1: If any COC exceeds its action level at any sampling zone, then we must determine if the aquifer at that zone is also capable of producing a sustained yield of 0.5 gpm for a period of 24 hours. If COC action levels are not exceeded at any sampling location, then we will proceed with SRPA monitoring (i.e., periodic monitoring).

DR-2: If the aquifer is capable of producing 0.5 gpm for a period of 24 hours from a zone that also exceeds COC action levels, then we must determine the volume of the hot spot. If the zone does not produce 0.5 gpm for 24 hours, then we will proceed with SRPA monitoring.

DR-3: If the volume of the COC hot spot is sufficiently large such that a future groundwater user could pump from the hot spot for a period of more than 1 year, then we are required to proceed with the contingent remedy. If the hot spot does not exceed the volume action level, then we will proceed with SRPA long-term monitoring.

**2.1.1.5 Specify Tolerable Limits on Decision Errors.** Five types of new information may be collected or developed during this study: (1) laboratory analytical data from groundwater samples, (2) borehole geophysical logs, (3) aquifer test results, (4) groundwater numerical modeling results, and (5) sedimentary interbed physical characterization (i.e., saturated hydraulic conductivity, bulk density, grain size distribution, and porosity). Because of the nature of logging and aquifer testing studies, statistically based decision error limits are not applicable and not required. Modeling information derived from the analytical data will not be directly amenable to statistical evaluation. Standard modeling error evaluation will be utilized to review the modeling results.

Laboratory analytical data collected during this study to determine if an action level is exceeded are amenable to statistically based limits on decision errors. Hypothesis testing will be utilized to determine if an action level is exceeded at any sampling point to resolve PSQ-1. The recommended null hypothesis,  $H_0$ , is that the true mean groundwater concentration for each COC is greater than or equal to the action level. The alternative hypothesis is that the mean is less than the action level:

$$H_0: \mu \geq \text{Action Level}$$

$$H_a: \mu < \text{Action Level}$$

This hypothesis testing will be based upon small sample statistics ( $n < 30$ ; where  $n$  is the total number of measurements) and utilize the t-test statistic:

$$\text{Test Statistic: } t = \frac{\bar{x} - \text{hypothesized value}}{s / \sqrt{n}}$$

Using this test statistic and hypothesis, we would reject the null hypothesis (and thereby accept the alternative hypothesis) if the test statistic  $t$  is less than the negative value of the  $t$  critical value obtained from standard math tables, given our number of samples and desired level of significance. This hypothesis testing will be performed to a level of significance, or  $\alpha$ , of 0.05. In other words, with this level of significance and null hypothesis, we limit the probability of a Type I error, or of rejecting the null hypothesis when it is in fact true, to only 5%. The proposed hypothesis testing is designed to allow us to control the probability of erroneously concluding that COC action levels are not exceeded when in fact they are exceeded. This null hypothesis was formulated based upon our belief that the harmful consequences of incorrectly concluding that an action level is not exceeded, when it actually is, is greater than the consequences of incorrectly concluding that the action level is exceeded when in fact it is not.

**2.1.1.6 Optimize the Design.** A project flowchart, presenting the conceptual design of the WAG 3 Group 5 field activities, is shown in Figure 2-1. The flowchart details the steps to be taken to both arrive at a contingent remedy decision and to perform the SRPA interim monitoring. The two separate flow paths are identified on the chart. The following paragraphs describe the rationale for the design of field activities related to the contingent remedy decision. The Group 5 decision to collect additional COC concentration and SRPA and interbed data prior to making a decision on implementation of the contingent remedy is based upon the need to evaluate the WAG 3 RI/FS model predictions of elevated I-129 concentrations in the SRPA, including the HI interbed, in 2095 and beyond. Because no physical characteristics or COC concentration data were available from the HI interbed to confirm the model predictions and no sensitivity analysis has been performed, we must collect empirical data on the presence of I-129 in the SRPA and physical properties of the HI interbed south of INTEC to support refinement of the groundwater model.



Given the basis for the field activities, prior to conducting these activities, available field data were reviewed and a sensitivity analysis on the HI interbed assumptions was performed. This review and analysis were performed to identify hydrologic data gaps. The model sensitivity analysis is presented in Appendix C.

Based upon the evaluation of the RI/FS modeling results, model sensitivity analysis, and existing data, one new well location has been selected (south of USGS-112 and USGS-113), four existing USGS wells have been selected for deepening (USGS-77, USGS-111, USGS-112, and USGS-113), and three existing wells, which already penetrate the HI interbed, have been selected for packer sampling (USGS-38, USGS-57, and USGS-67) (Section 4 contains a figure with well locations).

The wells will be drilled in a manner that allows for the collection of sedimentary samples from the HI interbed for analysis of physical characteristics and COC concentrations. Following drilling, borehole geophysical and fluid logging will be performed on the new wells (and any previously existing wells selected for profiling) to identify sampling locations for COC vertical profile sampling. The geophysical logging will consist of natural gamma, caliper, deviation, and video logging. Borehole fluid logging will consist of borehole flow, temperature, and specific conductivity. These logs will be reviewed prior to groundwater sample collection to identify the specific zones within each borehole for sampling.

Groundwater sampling will be conducted using a packer system and sampling pump to isolate the specific zone being sampled. Except for the interbed samples, one sample will be collected from each sampling zone. Because of concerns about borehole collapse or sloughing in the interbed, water samples from the interbed will be collected on the way down during drilling. The borehole will be extended approximately 1.5 m (5 ft) into the interbed. The first sample will be taken using a single packer system and will consist of packing off the basalt at the interbed basalt interface. A bottom packer will not be used for the interbed sampling. To guard against equipment getting trapped in the hole, the pump will be placed above the packer and a screen placed below the packer in the interbed. Replicate samples for Tc-99 and I-129 will be collected during interbed sampling. The replicate Tc-99 samples will be analyzed and the replicate I-129 sample held in storage until the results are determined for the I-129 and Tc-99 samples. The replicate samples will be analyzed for Tc-99 to confirm the original sample results. If I-129 is above the action level, the replicate I-129 sample will be analyzed. An aquifer stress test, a slug test, will also be performed at the time of sampling.

Following sample collection and analysis, the data will be reviewed to determine if the COC action levels are exceeded in any sampling zone. If the COC action level is exceeded in a zone, the zone will again be isolated with packers and pumped for a period of 24 hours to determine if the zone will yield groundwater at a rate of 0.5 gpm for the duration of the test. One water sample will be collected every four hours during pumping to determine if the COC action levels are also exceeded throughout the pumping test.

If COC action levels are exceeded and the aquifer at the sampling zone(s) yields a sustained 0.5 gpm for a 24-hour period, isopleth maps will be developed from the COC concentration data to estimate the volume of the hot spot(s). It is possible that additional wells may be required to estimate the hot spot volume. If additional wells are determined necessary, they will be drilled and then tested in the same manner as described above. The final volume estimates will be compared to the model-derived volume action level to determine if it has been exceeded. These results will be reported in the Group 5 monitoring report/decision summary.



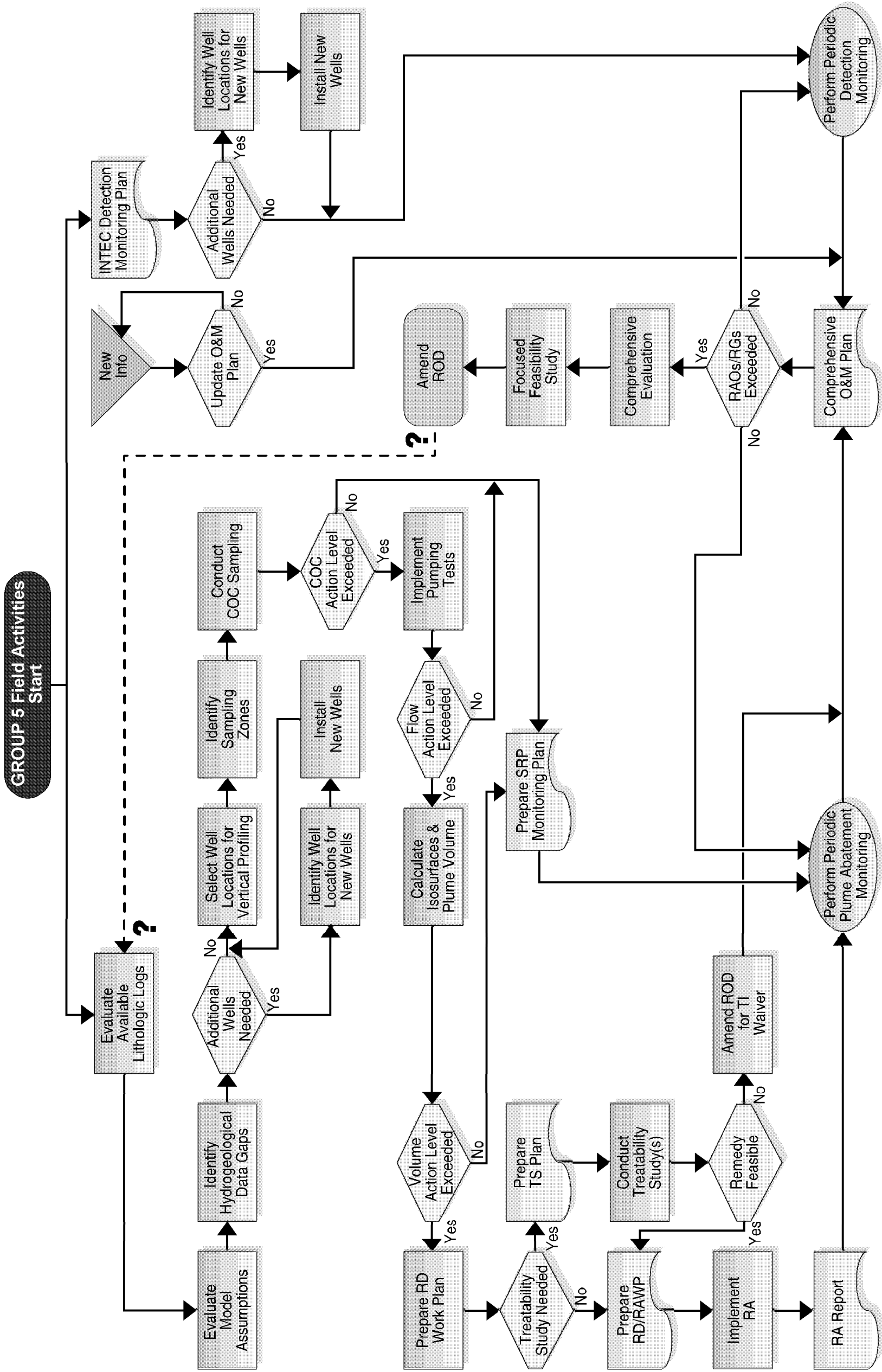


Figure 2-1. Project flow chart showing conceptual design of field activities.

## 2.1.2 Long-Term Monitoring DQOs

The following sections present details on each of the DQO steps to be answered by the work conducted under this LTMP. A summary of INTEC facility monitoring DQOs is presented in Table 2-1.

The possibility of COC flux in the SRPA originating from sources within INTEC, either in the vadose zone or in the vicinity of the former INTEC injection well, must be quantified. The concentration of contaminants downgradient of INTEC also needs to be monitored. These data can be used to update and refine the OU 3-13 numerical groundwater model to better predict the state of the aquifer in 2095.

**2.1.2.1 Identify the Decision.** This step of the DQO process lays out the principal study questions, alternative actions, and corresponding decision statements that must be answered to effectively address the problem stated above. The remediation goal for OU 3-13, Group 5 is “Achieving the applicable State of Idaho groundwater standards or risk-based groundwater concentrations in the SRPA plume south of the INTEC security fence by the year 2095” (ROD, Sec. 8.1.5, pg 8-10). To determine if this goal will be met, the input of contaminants to Group 5 from the contaminated aquifer within the INTEC security fence and the distribution of contaminants in the aquifer outside the INTEC security fence must be determined. To further assist in this evaluation, the groundwater modeling conducted as part of the OU 3-13 RI/FS will be utilized and refined with data collected under this LTMP.

**2.1.2.1.1 Principal Study Questions.** The purpose of the PSQ is to identify key unknown conditions or unresolved issues that, when answered, provide a solution to the problem being investigated. The PSQs for this project are the following:

- PSQ-1: Is the COC flux in the SRPA from the contaminated media in the vadose zone within the INTEC security fence of sufficient magnitude to prevent achieving the Group 5 remediation goals?
- PSQ-2: Is the COC flux in the SRPA from the contaminated sediments/sludges remaining in the former ICPP injection well (CPP-3) and immediate vicinity of sufficient magnitude to prevent achieving the Group 5 remediation goals?
- PSQ-3: Are the COC concentrations in the SRPA outside the INTEC facility of sufficient magnitude to prevent achieving the Group 5 remediation goals?

**2.1.2.1.2 Alternative Actions.** Alternative actions are those actions resulting from resolution of the above PSQs. The types of actions considered will depend on the answers to the PSQs.

**2.1.2.1.3 Decision Statements.** The DSs combine the PSQs and alternative actions into a concise statement of action. The DSs are

- DS-1: Determine whether the flux of contaminants in the SRPA that originate in the vadose zone within the INTEC security fence is of sufficient magnitude to exceed the Group 5 remediation goals in 2095.
- DS-2: Determine whether the flux of contaminants in the SRPA from the former INTEC injection well is of sufficient magnitude to exceed the Group 5 remediation goals in 2095.
- DS-3: Determine whether the COCs in the SRPA outside the INTEC facility will exceed the Group 5 remediation goals in 2095.

It is important to realize that the installation of an updated monitoring system and collection of new types of data during the SRPA monitoring might modify the site conceptual model for vadose zone flow and transport beneath WAG 3. If the conceptual model is significantly changed, DS-1 and -2 may need to be reevaluated accordingly.

**2.1.2.2 Identify Inputs to the Decision.** This step of the DQO process identifies the informational inputs that are required to answer the DSs made above.

**2.1.2.2.1 Inputs for PSQ-1.** PSQ-1 will be answered by collecting data on the COC flux originating in the vadose zone within the INTEC security fence, updating the OU 3-13 aquifer numerical model, and evaluating the predictions of the updated aquifer numerical model for COC concentrations in 2095.

Inputs to PSQ-1 are

1. Samples of selected wells upgradient of, near the boundary of, and within the INTEC security fence line, and analysis for COCs. Selected wells will sample in the upper 15 m (50 ft) of the SRPA.
2. Measurements of water table elevations for evaluation of groundwater elevation contours and flow direction.
3. Periodic incorporation of new data and update of the OU 3-13 aquifer numerical model for prediction of COC concentrations in the SRPA at 2095 and beyond.

**2.1.2.2.2 Inputs for PSQ-2.** PSQ-2 will be answered by collecting measurements of COC flux originating from the former injection well within the INTEC security fence, updating the OU 3-13 aquifer numerical model, and evaluating the predictions of the updated aquifer numerical model for COC concentrations in 2095.

Inputs to PSQ-2 are

1. Borehole geophysical and fluid logging of selected wells that penetrate the HI interbed for selection of wells and sampling zones below the HI interbed downgradient of the former injection well
2. Isolation through packers or other method(s), sampling, and analysis for COCs of selected well zones below the HI interbed downgradient of the former injection well
3. Measurements of water table elevations to contour of groundwater elevations and to determine flow direction, and possibly head gradient between the aquifer above and below the HI interbed
4. Periodic incorporation of new data and update of the OU 3-13 aquifer numerical model for prediction of COC concentrations in the SRPA in 2095 and beyond.

Isolation of sampling zone(s) beneath the HI interbed depth from selected wells should not preclude the sampling of zone(s) above the HI interbed from the same well to supply inputs for PSQ-2.

**2.1.2.2.3 Inputs for PSQ-3.** PSQ-3 will be answered by collecting measurements of COCs in the aquifer beyond the INTEC security fence line and by updating the OU 3-13 aquifer numerical model.

The inputs to PSQ-3 are

1. Sampling of selected wells downgradient of the INTEC security fence and analysis for COCs. Selected wells will monitor contaminants above MCLs and monitor the downgradient plume area above MCLs.
2. Measurement of water elevations for evaluation of groundwater elevation contours and flow direction.
3. Periodic incorporation of new data into the OU 3-13 aquifer numerical model for the prediction of COC concentrations in the SRPA in 2095 and beyond.

**2.1.2.3 Define the Boundaries of the Study.** This study will focus on the SRPA beneath INTEC, near the boundary of the facility and downgradient of the facility. The area of focus is the south and west boundaries because of the south-southwest direction of groundwater flow in this region.

The primary sources of contaminants to the aquifer include both the perched water/vadose zone above SRPA and the former injection well that penetrates the aquifer and HI interbed. Two PSQs have been identified to evaluate these sources separately.

The portion of the aquifer that is likely to be affected by contaminants transported through the vadose zone is the upper 15 m (50 ft) of the aquifer above the HI interbed.

Because the former injection well penetrated the HI interbed, the portion of the aquifer potentially affected by the injection well includes both the upper zone from the water table to the HI interbed and the lower zone beneath the HI interbed. The total depth of the former injection well was 182 m (598 ft). Accordingly, the base of the study boundary should correspond to the total depth of injection, or approximately 183 m (600 ft) bgs.

The third PSQ addresses monitoring of contaminants already present in Group 5 downgradient of INTEC. The long-term plume monitoring will monitor the concentrations of COCs as far downgradient of the INTEC facility as indicated by the detection of COCs above MCLs.

Because the remediation goal is established in the year 2095, this study will continue through the institutional control period to at least 2095.

**2.1.2.4 Develop a Decision Rule.** This step of the DQO process brings together the outputs from Steps 1 through 4 into a single statement describing the basis for choosing among the listed alternatives. If the monitoring activities and model predictions generated for this study indicate that Group 5 RAOs/remediation goals (RGs) will be exceeded due to the flux of contaminants in the SRPA beneath INTEC, then a comprehensive evaluation, focused feasibility study, and ROD amendment will be prepared to address the risks posed by groundwater contaminants beneath INTEC. If it is determined that the RAOs/RGs will be met, monitoring will continue until 2095 or until the agencies determine that no unacceptable risk exists from Group 5.

The decision is based upon model predictions using data obtained from an observational well network to model evolution of the plume.

**2.1.2.5 Specify Tolerable Limits on Decision Errors.** This step of the DQO process specifies acceptable limits on decision error. These limits are used to establish performance goals for the data collection design. In this case, the decisions will be made by evaluating computer predictions, and, thus, the accuracy of the computer predictions will bound the tolerable limits on the decision errors.

**2.1.2.6 Optimize the Design.** A flow chart presenting the conceptual design of the Group 5 field activities is provided in Section 2, Figure 2-1. The flow chart details the steps to be taken to both arrive at a contingent remedy decision and to perform the SRPA interim monitoring. The two separate flow paths are identified on the chart. The following paragraphs describe the rationale for the design of field activities related to the contingent remedy decision.

Thirty-six wells that are available in the vicinity of INTEC are suitable for groundwater monitoring. From that set of wells, 11 are selected for the INTEC facility-monitoring program to support PSQ-1, monitoring of the contaminant input from the vadose zone to the SRPA. The PSQ-1 INTEC facility monitoring will consist of groundwater sample collection from wells located upgradient of, within, and adjacent to INTEC. The wells selected for monitoring include MW-18, USGS-40, USGS-42, USGS-47 through USGS-49, USGS-51, USGS-52, and USGS-122 through USGS-123 (a figure in Section 4 gives well locations). One well, USGS-121, was selected upgradient of the contaminant source areas at INTEC to provide background groundwater quality data. Though this well is not directly upgradient of the INTEC facility, it is located nearer to the groundwater flow paths from potential sources of upgradient contamination (TRA or Naval Reactors Facility) than other wells and is, in that respect, well suited for providing upgradient water quality data. Several wells were selected inside INTEC (MW-18, USGS-47, USGS-48, USGS-49, and USGS-52) to help distinguish between the possible sources of groundwater contaminants. Wells USGS-40, USGS-42, USGS-51, USGS-122, and USGS-123 were selected because they are located along the southern and western boundaries of INTEC. The general direction of groundwater flow beneath INTEC is interpreted to be to the south-southwest. The selected wells are considered adequate for the INTEC facility monitoring and no new wells are considered necessary at this time. However, additional wells are currently planned for various other monitoring programs at INTEC. As these wells become available, they will be considered for inclusion into the INTEC facility-monitoring program.

The three wells selected for monitoring in support of PSQ-2, former injection well monitoring, are USGS-41, USGS-48, and USGS-59, based upon an evaluation of their suitability for monitoring the aquifer below the HI interbed. There are 12 USGS wells in the vicinity of INTEC and the former injection well that penetrate the HI interbed and remain as open boreholes in the aquifer, potentially suitable for long-term monitoring of the aquifer beneath the HI interbed (excluding INTEC production wells that are required for facility support and cannot be modified to sample below the HI interbed). The wells are USGS-40 through USGS-49, USGS-51, USGS-52, and USGS-59. These wells are located either cross-gradient or downgradient of the former injection well. An evaluation of available data from, and additional geophysical and borehole fluid logging of, these wells will be performed to determine if the selected wells are suitable for deep sampling and to identify potential zones for sampling. (Note: because these wells are completed with an open borehole, there is a significant possibility that the deeper portions of one or more of these may be obstructed, requiring the selection of an alternate well from the 12 wells identified above). It should be noted that an upgradient monitoring well that penetrates the HI interbed is not available within the existing monitoring well network at INTEC. Well USGS-121 does not penetrate the HI interbed. Production wells CPP-1, CPP-2, and CPP-4 have been drilled through the HI interbed and have perforated well casing both above and below the HI interbed but are of limited use as monitoring wells based upon their required support of INTEC operations. The need for an upgradient monitoring well in this zone will be evaluated after the monitoring program is initiated. If the data obtained from the facility monitoring program indicate that the injection well may cause or contribute to not meeting the Group 5 RAO/RGs, an upgradient well will be installed for sampling beneath the HI

interbed to ensure that there is no upgradient contaminant source present. Also, current plans for OU 3-14 investigation include the installation of a monitoring well in the immediate vicinity of the former injection well. As the additional well(s) become available, they will be incorporated into the INTEC facility monitoring well program to provide additional data in the vicinity of the injection well.

In addition to the above monitoring, one sampling round will be conducted using the entire INTEC monitoring network at the onset of the activities outlined in this LTMP. This baseline sampling event will provide information on the current state of the contamination of the SRPA in the vicinity of INTEC and provide a data set to compare the COC flux monitoring data. These data will be used to update the OU 3-13 numerical aquifer model. In support of Group 4 activities, groundwater samples collected during the baseline sampling event from USGS-40, -42, -47, -48, -49, -51, -52, -121, -122, -123 and MW-18 will be analyzed for stable isotopes, including oxygen, hydrogen, and nitrogen.

Micropurge samples will be collected from the 20 wells in the semiannual sampling in the first year. The standard samples and the micropurge data will be analyzed by statistical methods to determine if the data are comparable. If the data sets are comparable, the micropurge method will be used to collect future samples. Statistical equivalency will be determined by doing a student t-test on the data and by looking at historical data to see if the data falls within historical trends. To determine equivalency based on the T statistic, the null hypothesis,  $H_0$ , assumes that the true mean difference is zero and is tested by comparing the t statistic to the appropriate tabled t value. If  $T < -t_{\alpha/2, n-1}$  or  $T > t_{\alpha/2, n-1}$ , where  $\alpha$  is the level of significance and n is the degrees of freedom, then null hypothesis is rejected and it is concluded that the true mean difference is significantly different from zero. If  $T > -t_{\alpha/2, n-1}$  and  $T < t_{\alpha/2, n-1}$ , then null hypothesis is accepted and it is concluded that there is not enough evidence to suggest that the true mean difference is significantly different from zero. This hypothesis testing will be conducted to a confidence level, or  $\alpha$ , of 0.05 or the probability of rejecting the null hypothesis when it is in fact true is 5%.

Six wells have been selected for long-term monitoring of the INTEC plume beyond the facility boundary in support of PSQ-3. The wells selected for long-term monitoring are USGS-57, USGS-67, USGS-112, USGS-113, USGS-85, and LF3-08. These wells were selected based on a review of the historical data for I-129. However, most of the data used to select these wells for long-term monitoring is from 1990–1991; therefore, the baseline groundwater sampling data will be used to optimize the well locations and the total number of wells for long-term monitoring.

Analytes of interest include COCs that currently exist in the SRPA at concentrations exceeding either MCLs or risk-based concentrations, as well as COCs derived from the modeling, which are predicted to potentially cause a future unacceptable risk to the SRPA. Contaminants that currently exceed MCLs or risk-based concentrations and will be included in the INTEC facility monitoring program are I-129, Sr-90, and tritium. Contaminants that are predicted by the WAG 3 RI/FS modeling to exceed MCLs or risk-based concentrations at a future date, and are included in the INTEC facility monitoring program, are plutonium and uranium isotopes, Np-237, Am-241, and mercury. Chromium, while listed as a COC, is excluded here because it is specifically related to groundwater contamination at TRA. Because Tc-99 is a contributor to the total beta-emitting radionuclide limit and is present at significant concentrations in the aquifer beneath INTEC, it is included in the list of analytes for INTEC facility monitoring. To evaluate additional radionuclides that may be present but not accounted for in the modeling, gross-alpha and gross-beta analyses will also be performed. Finally, the list of analytes will be updated through either the exclusion of some analytes or inclusion of additional analytes as analytical data are accumulated or new information regarding contaminant sources is identified. The detection limits for I-129, Sr-90, and tritium required to make the decisions needed concerning the contingent remedy are 0.1 pCi/L, 0.8 pCi/L, and 2,000 pCi/L, respectively.

Sampling and analyses will occur at the following frequency:

Year 1	Baseline and Semiannual	Tritium, Tc-99, I-129, Sr-90, plutonium isotopes, uranium isotopes (U-234, -235, and -238), Am-241, Np-237, Cs-137, gross-alpha/beta, and mercury; metals and anions in semiannual and micropurge sampling only
Years 2–7	Annual	Tritium, Tc-99, I-129, Sr-90, plutonium isotopes, uranium isotopes (U-234, -235, and -238), Am-241, Np-237, Cs-137, gross-alpha/beta, and mercury
Years 8–16	Biannual	Review and adjust as required
Years 17–100	Once every 5 years	Review and adjust as required.

Following each sampling event and prior to each CERCLA 5-year review, the new groundwater sampling results will be compared against the OU 3-13 aquifer model predictions to determine how concentrations compare to the model predicted trends. If the new data indicate the necessity, the model will be updated, generating new COC concentration predictions. These predictions will be compared against the Group 5 RAO/RGs to determine if they will be exceeded. If the data trends exceed model-predicted trends and indicate a potential to exceed the Group 5 RAO/RGs, the sampling frequency will revert to annual sampling and progress in a manner similar to the schedule above.

**2.1.2.7 State the Problem.** The WAG 3 ROD requires monitoring activities to determine whether present contaminants in Group 5 or the flux of contaminants originating from within the INTEC security fence will affect the aquifer such that Idaho groundwater quality standards or risk-based concentrations will not be met in Group 5 in 2095.

### 2.1.3 Performance Standards (RAOs and RGs)

**2.1.3.1 Remedial Action Objectives.** The remedial action for Group 5, Snake River Plain Aquifer, will be evaluated against the RAOs and RGs established in the WAG 3, OU 3-13 ROD (ROD, Section 8). The RAOs for OU 3-13 were developed in accordance with the S.O. NCP and CERCLA RI/FS guidance. The RAOs specify the contaminants and media of concern, potential exposure pathways, and RGs. The RGs establish acceptable exposure levels that protect human health and the environment. Factors that are considered in establishing RGs are outlined in 40 CFR 300.430(e)(2)(1). RAOs are specific risk criteria that take into consideration the assumed future land uses at INTEC. The RAOs are primarily based on the results of the baseline risk assessment and ARARs.

The INTEC land use assumptions used to develop the RAOs include industrial use prior to 2095 and potential residential use after that time. Other assumptions used to develop the RAOs, as listed in the ROD, include

- The INTEC facility will be used as an industrial facility up to the year 2095. During the period of DOE operations, expected to last to at least 2045, this area is a radiological control area. Only the contaminated groundwater present in the SRPA outside of the current INTEC security fence is addressed in the OU 3-13 ROD. The selected remedy is expected to fully address this contamination. However, this action does not address groundwater inside the INTEC security fence, which will be addressed under OU 3-14.

- For the time period 2095 and beyond, it is assumed that the SRPA located outside the current INTEC security fence will be used as a drinking water supply.
- The annual carcinogenic risk at the INTEC from natural background radiation due to surface elevation and background soil radiological contamination is  $10^{-4}$  (EPA 1994, NEA 1997, UNEP 1985).
- Permanent land use restrictions will be placed on those release site source areas and the ICDF Complex, which will be closed in place, for as long as land use and access restrictions are required to be protective of human health and the environment.

To achieve a reasonable degree of protection at the WAG 3 sites, the Agencies have selected a remedy for each group of sites that meet the RAOs. These remedies protect human health and the environment and meet regulatory requirements. The WAG 3 RAOs were developed for specific media (i.e., soils, perched water, or groundwater). The applicable RAOs for a particular site or group of sites depend on the specific media impacted. The RAOs, which are listed in Section 8 of the ROD, and are directly applicable to Group 5, include

**Note:** RAO numbering below is same as in ROD

1. Groundwater:
  - a. For INTEC-impacted groundwater located in the groundwater contaminant plume outside the INTEC security fence, restore the aquifer for use by 2095 and beyond, so that the risk will not exceed a cumulative carcinogenic risk of  $1 \times 10^{-4}$  for groundwater ingestion.
  - b. For INTEC-impacted groundwater located in the groundwater contaminant plume outside the INTEC security fence, restore the aquifer to drinking water quality (below MCLs) for use in 2095 and beyond.
  - c. For INTEC-impacted groundwater located in the groundwater contaminant plume outside the INTEC security fence, restore the aquifer so that the noncarcinogenic risk will not exceed a total hazard index (HI) of 1 for groundwater ingestion.
2. Snake River Plain Aquifer (INTEC-derived groundwater contaminant plume outside the INTEC security fence):
  - a. In 2095 and beyond, ensure that SRPA groundwater does not exceed a cumulative carcinogenic risk of  $1 \times 10^{-4}$ ; a total HI of 1; or applicable State of Idaho groundwater quality standards (i.e., MCLs).

**2.1.3.2 Remediation Goals.** To meet the RAOs, remediation goals are established. These goals are quantitative cleanup levels based primarily on risk to human health and the environment. The remediation goals are based on the results of the baseline risk assessment and evaluation of expected exposures and risks for selected alternatives. If an ARAR is more restrictive, then the ARAR standard is used as the remediation goal. The remediation goals will be used to assess the effectiveness of the selected remedial alternatives in meeting the RAOs. RAOs, discussed below, were developed in the ROD in Section 8.

Remediation goals for INTEC-derived COCs in the SRPA groundwater outside the INTEC security fence are based on the applicable State of Idaho groundwater quality standards (IDAPA 16.01.011.200). The SRPA COCs consist of H-3, Sr-90 and daughters, I-129, Np-237, chromium, and mercury until 2095,



and Sr-90, I-129, Np-237, plutonium and uranium isotopes and their daughters, and mercury in 2095 and beyond. The SRPA groundwater remediation goals for these COCs are presented in Table 2-2.

The remediation goal for INTEC-derived alpha-emitting radionuclides (i.e., Np-237, Pu isotopes and their daughters, Am-241, and U isotopes and their daughters) in the SRPA groundwater outside the current INTEC security fence corresponds to a cumulative alpha-activity of 15 pCi/L in the year 2095 and beyond. WAG 3 RI/FS modeling has shown that alpha-emitting radionuclides are not expected to exceed the 15 pCi/L standard in the SRPA inside the current INTEC security fence until the year 2750, with a peak concentration occurring in the year 3804. Remediation, if necessary, of the tank farm inside the current INTEC security fence is expected to mitigate the future alpha-emitting radionuclide impacts in the SRPA outside the current INTEC security fence. Remediation goals for the alpha-emitting radionuclides in the SRPA inside the current INTEC security fence will be established in the final action developed in OU 3-14.

The remediation goal for beta/gamma-emitting radionuclides (H-3, Sr-90 and daughters, and I-129) in SRPA groundwater outside the current INTEC security fence is restricted to a cumulative dose of 4 mrem/yr in the year 2095 and beyond. The remediation goals for chromium and mercury are 100 µg/L and 2 µg/L, respectively, for individual constituent MCLs.

#### 2.1.4 Performance Measurement Points

The Group 5 RA performance will be evaluated against the Group 5 RAOs and RGs discussed above. The performance measurement point for the Group 5 RA resides in the SRPA at the boundary of the INTEC security fence where COC concentrations must not exceed either a carcinogenic risk of  $1 \times 10^{-4}$ , an HI of 1, or drinking water standards (i.e., MCLs) in the year 2095 and beyond. All wells downgradient of the INTEC boundary must similarly meet drinking water standards by 2095.

**Table 2-2.** SRPA contaminant of concern remediation goals.

Contaminant of Concern	SRPA Remediation Goals (Maximum Contaminant Levels) For Single COCs	Decay Type
<u>Beta/gamma-emitting radionuclides</u>	Total of beta/gamma-emitting radionuclides shall not exceed 4 mrem/yr effective dose equivalent	Beta/gamma
Sr-90 and daughters	8 pCi/L	Beta
Tritium	20,000 pCi/L	Beta
I-129	1 pCi/L as sole β-γ emitter, all included to demonstrate compliance against 4 mrem/yr	Beta/gamma
<u>Alpha-emitting radionuclides</u>	15 pCi/L total alpha-emitting radionuclides	Alpha
Uranium and daughters	15 pCi/L this includes all α emitters except as specified in 40 CFR 141.16	Alpha
Np-237 and daughters	15 pCi/L this includes all α emitters except as specified in 40 CFR 141.16	Alpha
Plutonium and daughters	15 pCi/L this includes all α emitters except as specified in 40 CFR 141.16	Alpha
Am-241 and daughters	15 pCi/L this includes all α emitters except as specified in 40 CFR 141.16	Alpha
<u>Nonradionuclides</u>		
Chromium	100 µg/L	Not applicable
Mercury	2 µg/L	Not applicable

However, because the RAO establishes that the performance criteria will be met in the year 2095 and beyond, present day measurement of whether or not RAOs are achieved is not possible. Numerical model predictions based on vadose zone moisture content and COC concentrations trends in both the vadose zone and the aquifer beneath the INTEC are required to determine if the RAO will be met in 2095 and beyond. The monitoring program for vadose moisture content and COC concentrations in both the vadose zone and SRPA is established (Note: perched water and vadose zone monitoring beneath INTEC will be accomplished under the Group 4 monitoring program) to support the numerical modeling. Data obtained from the soil moisture monitoring and COC concentration sampling, as well as additional data regarding stratigraphy, lithology, and other new information, will be incorporated into the WAG 3 model to periodically update the model predictions for COC concentrations in 2095. Until the year 2095, this modeling will be utilized to predict whether the RAOs are being met.

### **2.1.5 Rationale for Selection of Performance Measurement Points**

Performance measurement points for Group 5 are based directly on the RAOs that are presented in the OU 3-13 ROD. The RAOs take into consideration land use assumptions and protect human health and the environment. The primary cause for establishing the performance measurement point at the security fence boundary of INTEC in 2095 is the land use assumption stating that the SRPA outside the INTEC security fence will be available for residential use in 2095. For this reason, water quality outside of the INTEC security fence in 2095 and beyond must meet drinking water standards.

### **2.1.6 Group 5 Snake River Plain Aquifer ARARs**

A complete listing of the applicable Group 5 ARARs, including an explanation of how they will be met on this project, is included in Section 3.2, Detailed Evaluation of How ARARs Will Be Met, in this document.

### **2.1.7 Technical Factors of Importance in Design and Construction**

***Drilling Through Perched Water***—The construction of monitoring wells south of INTEC may involve drilling through zones of perched water. Well construction design for these wells must account for the potential difficulties in encountering saturated zones above the water table, primarily in the form of flowing sediments or large volumes of water draining down the well as drilling proceeds through and below the saturated zones. For this reason, it will be necessary to seal these saturated zones from the borehole. This will generally be performed through grouting and casing the unstable zone, reducing the drill bit size, and continuing drilling to the target depth.